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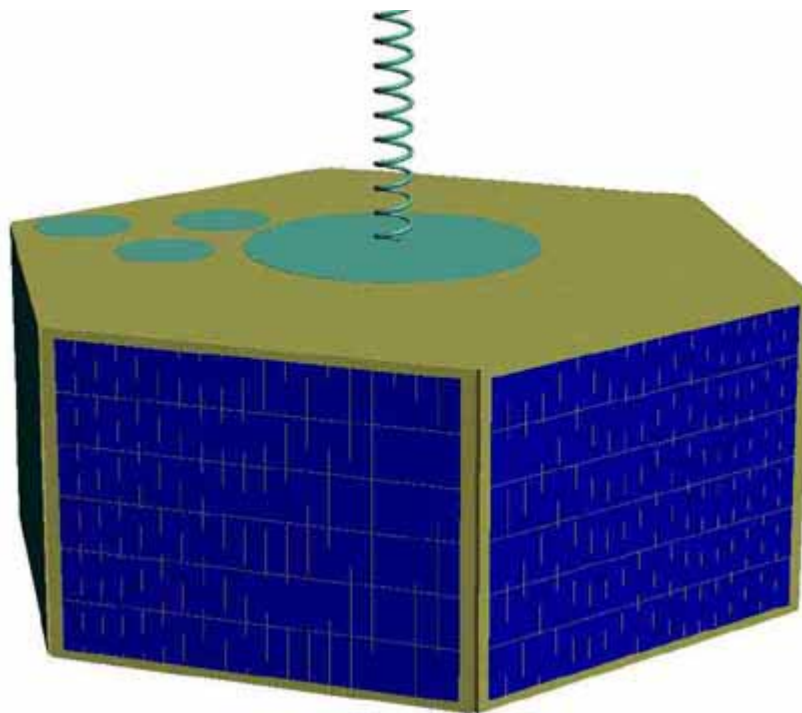


Figure 1. Rendered Overview of Proposed Phase 3E Satellite.

So You Want to Build a Satellite!

Dick Jansson, WD4FAB

Recent conversations among the Amateur Satellite community have shown an interest in a low-cost replacement for an AMSAT-OSCAR 13 (AO-13) type of mission. AO-13 was a popular satellite, indeed, and having a low cost follow-on replacement is an attractive idea. It is not that there is anything wrong with the Phase 3D (AO-40) mission, but it has taken over ten years and many dollars (and Deutsch Marks) to bring to fruition. Is such a new mission possible? The answer to that lies in getting a properly sized

[continued on page 4]

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Straight Key Night on OSCAR Results

Ray Soifer, W2RS reports that the following participants in AMSAT-NA's 2001 Straight Key
Night on OSCAR were nominated for *Best Fist* honors:

Thomas Hart, AD1B, Dedham, MA
Thomas McGrane, K2ISS, Westhampton, NY
Cliff Buttschardt, K7RR, Morro Bay, CA
Peter, Lawn, WA6DFU, San Luis Obispo, CA
Alan Lyday, Sr., WC9C, Pimento, IN

Congratulations to all and see you next year!



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Apogee View

Next Steps

As someone once said: "the only thing that is constant is change" and so it is with AMSAT. When I wrote the last Apogee View it looked as though AO-40 was a great success and in almost perfect health. After a wonderful launch on Ariane 507 it seemed as though we were destined to have many years of almost perfect amateur satellite communications through that satellite.

Now the view is somewhat different, at the time of writing in mid-January as too many questions remain to be answered. We do know that it is possible to communicate with AO-40 through L-band and S-Band. We are fairly certain that the V-Rx and U-Rx are in good shape when operating through the hi-gain antennas, and we know that the magnetorquing system works, this is on the positive side.

There are a number of things that are on the negative side of the equation, such as the possibility of a continuous leakage of fuel, loss of the general omni-directional antennas and the loss of some sensors. Other things including the operation of the U- and V-band transmitters are currently unknown. But one thing is certain and that is, in spite of the excellent hard work by the command team, we will not have a fully operational AO-40 as we had initially anticipated.

Hard work by the command team and time, will tell us what operations will be available to us, and I do not intend to speculate, but whatever the situation is, the time has now come to look toward future satellites that may be built and launched.

As some of you may be aware, about a year ago AMSAT formed a *Project Committee* to advise the Board of Directors (BoD) on various aspects of future satellite projects. This committee comprises a number of people representing different aspect of the AMSAT membership, in order to get a balanced viewpoint when making recommendations to the BoD.

In December of last year, I asked the *Project*

Committee to review two papers that had been presented at the 18th AMSAT Annual Meeting and Space Symposium in Portland, Maine. In addition Tom Clark, W3IWI asked for a review of another set of ideas and Bill Tynan, W3XO has also given the committee his recommendations. Currently there is an excellent e-mail discussion going on between members of the *Project Committee* and they are developing a preliminary proposal for discussion at the next Board of Directors meeting to be held at the end of February 2001.

My personal impression of the *Project Committee's* discussions is that they are taking into account the general membership requirements, while still developing innovative ideas within a reasonable budget!

I hope that the details of this preliminary study will be released following the Board meeting in a subsequent issue of *The AMSAT Journal*. Meanwhile I can recommend that the papers by Jeff Davis, N9AVG and Dick Jansson, WD4FAB in the proceedings of the symposium together with Dick's update in this issue of *The AMSAT Journal* is worth reading.

Following a review by the Board, I anticipate that some funding will be allocated to allow the project committee to carry out a full feasibility study that will include costs and schedule. At that time also a search for a launch would commence.

How long will the process take? Well that depends on the proposals put forward by the Project committee, the availability of funds and a suitable launch. In other words it is too early to say at this time, but I hope that in the feasibility study a reasonable schedule is developed.

Membership of AMSAT will always have its advantages and as always one of the biggest advantages is to get *The AMSAT Journal*, where details of our new projects will be revealed first.

73, Robin Haighton, VE3FRH, President ■

AMSAT-DC Meeting and Space Seminar

1300 hrs., Sunday, 01April 2001
NASA Goddard Space Flight Center, Greenbelt, MD

For complete details see: <http://simts.gsfc.nasa.gov/ssamsatdc.html>
or contact Pat Kilroy, N8PK (n8pk@amsat.org)
Informal talk-in is on WA3NAN/R 146.835 MHz Greenbelt, MD

[Continued from page 1]

spaceframe holding a limited amount of equipment, to a Geosynchronous Transfer Orbit (GTO). Low-cost also implies a mission without propulsion. Other papers will deal with some of these aspects of such a mission. It is the intent of this paper to show how a practical spaceframe can be designed for existing launchers and launch environments.

The Challenge

A significant number of us, from fourteen different countries, have worked a rather long time to bring the AO-40 spacecraft to the point of being ready for launch - too long of a time, more than ten years. We have poured our hearts into this project and it is a masterpiece, including the proverbial *kitchen sink*. Since the loss of AO-13, the amateur

satellite community has also been at a loss for a high-altitude, *worldwide* communications satellite platform. Many of us feel that a ten year gestation time for bringing a satellite to fruition is much too long, especially at a time when we do not have a fully useable global communications platform. (The ailing AO-10 does not fill that bill.)

When we combine these factors into a cohesive set of brain waves we can conclude that we need to think of new, high-altitude satellites that truly fit the concept of AMSAT's famous KISS principle of design. Such a design *must* be low cost, easy to build and easy to launch. Now, the list of what constitutes a simple satellite design certainly can be debated, depending upon one's interests in satellite communications. There is some consensus on the following list of key points of such a design, however:

- High altitude orbit for wide area coverage and long-distance DX operations
- Transmitting and receiving equipment for wide-band, multi-user SSB operations
- No propulsion
- No more than three years from start to launch
- Cost less than \$500,000
- Re-use as much prior design technology as possible
- Weight less than 50 kg

Such a list of *requirements* may seem oppressive, but let us see how these play into making something simple that we can collectively afford, construct and operate.

All of the AMSAT Phase 3, high-altitude elliptical orbit spacecraft have had their orbital start by being launched into an orbit called Geosynchronous Transfer Orbit, or just GTO for short. This is the intermediate orbit achieved by a launcher placing a synchronous orbit satellite into space. This is an elliptical orbit with an apogee of about 36,000 km and a low perigee. Such high altitudes have proved popular with Amateur satellite users for really wide area communications coverage, giving pleasurable, unpressured intercontinental communications for many hours at a time, unlike low-earth-orbit (LEO) satellites. As the coverage of the earth is large, such orbits are popular with the DX operator in many of us.

Similarly popular have been the bandwidths of the transmitting and receiving equipment (transponders) of satellites such as AO-10 and AO-13, as they provided lots of

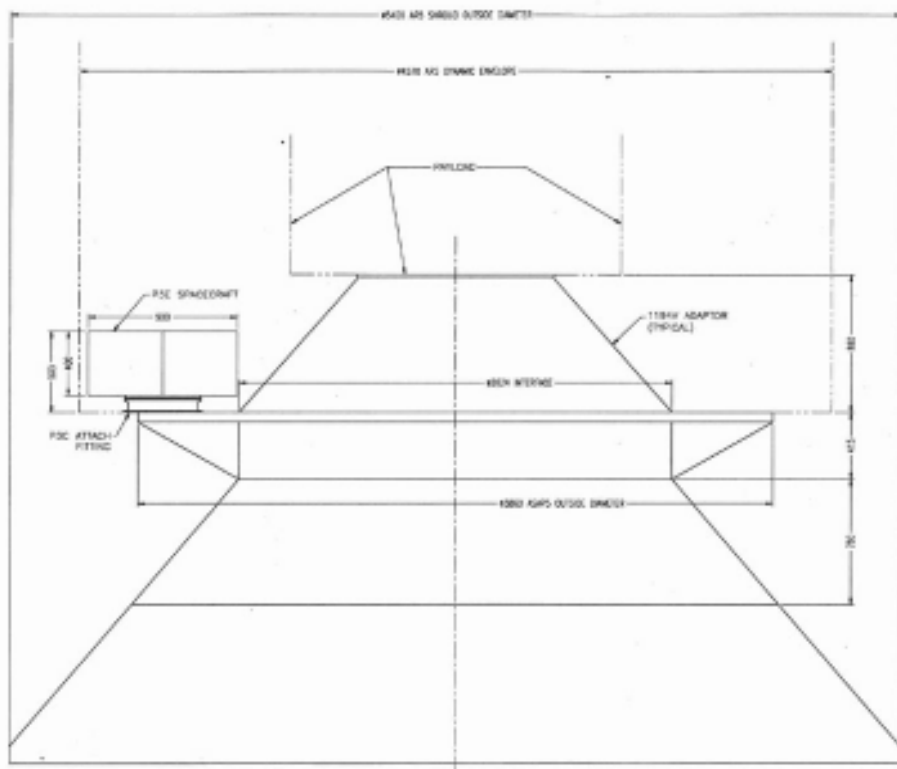


Figure 2A. Available Space on for Phase 3e Satellite on Ariane 5 ASAP.



Figure 2B. Phase 3D mounted on the Ariane 5 ASAP during launch preparations.

elbowroom for many simultaneous SSB QSOs. AO-40 will also have these features, which allow many operators to use the satellite at the same time, in deference to the single-channel FM LEO satellites.

GTO operations typically have an orbit with an apogee of about 36,000 km and a low perigee of only hundreds of kilometers. The Ariane 4 launches, that placed AO-10 and AO-13 into orbit, had characteristic perigee values of 200-300 km and thus required quick action by the spacecraft controllers, using on-board propulsion systems, to raise this low perigee to avoid orbital decay. The Ariane 5 launcher is a different story, as it leaves satellites in a GTO with perigee values in the range of 600 km, and the orbital drag of that perigee is insignificant, eliminating the need for any perigee-raising propulsion. On-board satellite propulsion systems are expensive and lend a very large element of complexity to a design. A satellite without propulsion really becomes light and fulfills our KISS goals.

Another target for this prospective satellite design is that it can be completed within a three-year period. This time is sufficiently short enough to be attractive to constructors to maintain their interests and application. Maintaining a cadre of volunteer constructors is a significant challenge; a short gestation period should enhance their retention to the program. We also need to maintain and retain the user and support communities. This becomes difficult with a lengthy program. This time concept also affects the funding efforts, as long programs cost more. While a target of \$500,000 is seen as a maximum, such a sum should be viewed as an absolute top limit and funding budgets should really be set to considerably lower values.

To construct this conceptual satellite we must think in terms of reusing as much of the broad technology base that we have created over the last 25 years. There are many good ideas. There are some ideas that are too expensive, or otherwise inapplicable. So those of us doing the scheming on this design have lots to choose from, and this will be explored with you in this paper. One clear goal of any such design deals with design concepts previously used, and *if it isn't broken, don't fix it*. One of the goals that benefits from our prior experience is that the completed satellite design must not be so heavy that it causes launching problems, and a 50 kg goal seems reasonable.

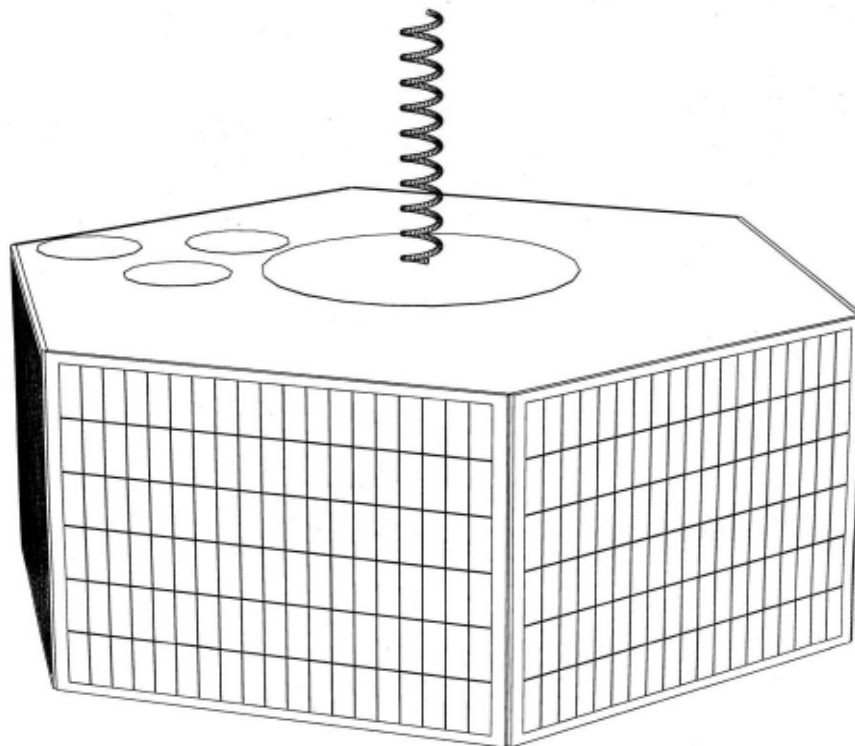


Figure 3. Phase 3E Line Overview.

Spaceframe Design

With the preamble complete, let me explore with you what kind of spaceframe can be constructed to meet these goals. The first concept is that the satellite must be able to

fit in an existing launcher that will provide us the desired GTO positioning.

Clearly I will not consider another AO-40 spaceframe as that is much too large and costly, although it fits the Ariane 5 launcher.

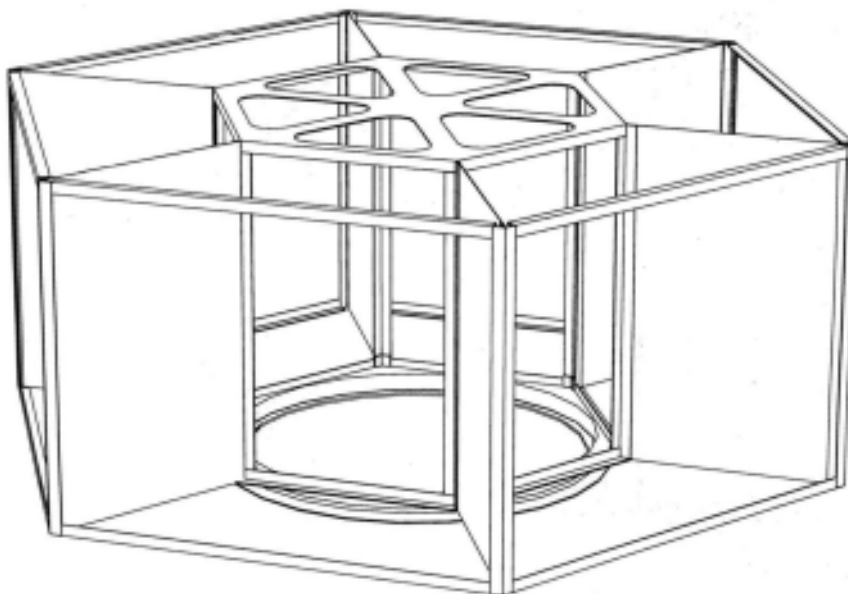


Figure 4. Phase 3E Spaceframe Skeleton.

Arianespace does have a mini-satellite launching platform with the Ariane 5, called ASAP5. In fact, the AMSAT Microsat satellites (AO-16, DO-17, WO-18, LO-19) were launched in 1990 on the very first ASAP implementation on an Ariane 4 launcher. For Ariane 5 the ASAP5 platform has gotten larger and more capable. The ASAP5 is not so large, however, that we could mount another Phase 3C (OSCAR 13 or AO-13) spaceframe. These limits rule out using one of the more recent existing spaceframe designs. We need to explore what kind of spaceframe can be placed on an ASAP 5 platform that will provide us with the satellite features that are desired.

Without consulting Arianespace on their ASAP5 payload limits, I can at least identify a geometry that is useful. Getting this design accepted for launch would be another matter and will not be explored in this paper.

Implicitly, the goals of this spaceframe are for a spin-stabilized operation that uses magnetorquer techniques for attitude and spin control, much as for AO-13 and for the early operations of AO-40. This then means that the mechanical design must insure that the design is spin stable about the desired axis.

Another key driver is that of power generation. AO-13 had an initial peak power generation of about 70 Watts, and used six solar panels of 400x540 mm. This power level is expressed as a beginning-of-life (BOL) and at a sun angle of $\beta = 0^\circ$ (Beta angle), fairly standard rating methods. Actual power use should not exceed 60-70% of the peak value, as solar cell age-decay and sun-angle conditions will not support higher power consumptions. This power level can be considered barely comfortable for the kinds of communication equipment that we would like to orbit. It is clear that the size limits of satellites that can be mounted on an ASAP5 platform also significantly restrict the power generating capability and thus maximum transmitter power output.

We would like to be able to reuse as much of the electronic equipment designs from AO-40 as possible, and this drives some of the internal spaceframe design. Some modules can be directly used from AO-40, while only the modular housing can be used for others. This will be explored later.

We cannot place a Phase 3C spaceframe on an ASAP5 platform, as it is too large, and AO-40 is too large and expensive. What is wrong with the geometric concepts of AO-40? This is exactly what went through my mind! I did not need to "invent" a new

geometry, just a new set of dimensions. Let me explore this one with you. Figure 1 is the result of this head-bone exercise, a design shape that you should recognize. Like most AMSAT satellites, this is really a flying antenna platform and the spaceframe shape helps supply that larger platform. I do not pretend to have completed antenna designs posted on top of this spacecraft, merely some useful representations and concepts borrowed from AO-40.

This design of spaceframe, which I will call Phase 3E (P3E) for this moment, is 900 mm across the flats of the hexagonal cylinder, and it is 400 mm high. This gives six solar panels that are 400x520 mm, very near the size of those for AO-13, and a power production of 82 W using GaAs ($\eta=18\%$) solar cells or 69 W using more conventional silicon BSFR ($\eta=15\%$) solar cells.

Well, now, how does this fit onto the ASAP5 platform? Actually I cheated and studied the fit before the shape that I have shown you. Figure 2A shows a sectional view of the Ariane 5 payload mounting to the upper propulsion stage. You can see that this is a large cavity as the $\phi 5400$ mm (5400 mm diameter) is 17.7 feet across the outside! The internal dynamic clearance inside of the shroud is still large at $\phi 4570$ mm. And the ASAP5 platform is $\phi 3860$ mm (Figure 2B). While this P3E spaceframe can fit on the ASAP5 platform at this point, there is no guarantee that it would be allowed. It turns out that the V clamp-band separation section used for AO-13 would provide a very nice mounting for the P3E.

Figures 3 & 4 show the line drawings of the assembled spaceframe and its structural skeleton. While I can guarantee that there will be changes in this design before any flight, the spaceframe design shown is plausible and is based on our AO-40 experiences. I have liberally employed the use of NC machining for this design, coupled with good sheet metal practices. Hopefully some of these NC parts can be reduced to sheet metal. The calculated all-up mass of this spaceframe is 10.6 kg and approximately 2 kg of fasteners will need to be added, totaling 12.6 kg, which places us well on the way toward a 50 kg spacecraft.

Payload Modules

This is probably the most controversial aspect of any such project, especially since most of our contributors to this are electronically inclined. I feel, however, that we cannot afford to load up on modules and experiments willy-nilly. We must stick to basics to hold down weight, cost, and development

time. We must reuse as many of the basic modular designs provided early on for AO-40. The concept has proven flexible and adaptable to a wide range of variants.

Another concept is that any module with significant power dissipation must be carefully scrutinized as we cannot afford a highly specialized spacecraft thermal system, as we have in Phase 3D. All of the higher power dissipation elements must be adaptable to conduction cooling, especially the transmitters. From AO-40 we do have some useful modular adaptations that can be used on P3E.

Now for the suggested module list:

- U Band transmitter, HELAPS
- S Band transmitter, HELAPS
- U, L & S Band receivers and preamplifiers
- IHU2 computer, adapted from P3D
- Sensor Electronic Unit (SEU), GPS and preamps
- Battery Charge Regulator (BCR)

The design shows that there are six equipment bays, and each can only hold a single stack of AO-40-type modules on the equipment panel that is 254x400 mm. The above list does not include a RUDAK as is on AO-40, even though I know that the digital experimenters will want one. Any such RUDAK unit must be able to operate on just 2-3 W, which is quite a change from Phase 3D as that module consumes 19 W running bare, and up to 32 W with everything cooking. This mission cannot afford such power-hog modules. The principal consumer of power on this P3E mission must be the prime payload, the RF communications equipment.

One experiment on the AO-40 mission will bear careful watching for its applicability to P3E. This is the spacecraft-wide buss system called CAN-LAN. When we first evolved the designs for AO-40, in the early 1990's, a common bus system was desired to reduce the wiring complexity and penalty. At that time, however, such buss systems had not evolved to the level of certainty that was needed to base the spacecraft electrical design upon. Nevertheless, work did proceed on flying a buss system as an experiment. The CAN buss system was determined to be applicable as integrated circuit chip-sets were becoming available. In AO-40 this buss system is widely used to interconnect experiments that are not mission critical. With success on the AO-40 mission, it may be worthwhile to use such a buss system as the principal interconnect method on P3E.

An area of potential controversy is that there

is no V Band equipment (2 meters). Principally this is a three-fold situation, being a lack of module and antenna spaces, and that there are more reliable Amateur communications that can be obtained using U, L and S bands.

Antennas

That we are all ham radio operators automatically makes all of us antenna experts! That comes with the territory. Now down to real antenna conditions. Shown in Figures 1 & 3 is one possible configuration. The large circular patch antenna is straight from the AO-40 spacecraft and is for U-band operations on 435-437 MHz. The P3E top surface is large enough to be able to hold three of these patch antennas for the desired gain, but then there would not be room enough for any other antennas. Thus only a single patch is shown for U-band.

Taking from our experience with the U-band patch antennas, an array of three patch antennas is shown for L-band operation on 1267-1270 MHz. This should provide useful gain of 10-12 dBic, less than for AO-40 but about correct for a spin-stabilized satellite in a 36,000 km elliptical orbit.

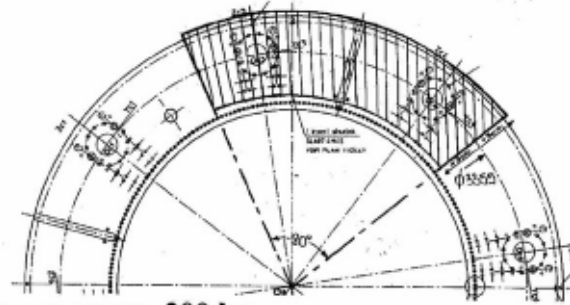
For S-band operations, in the range of 2400-2402 MHz, a small Helix antenna is shown. AO-40 uses such a Helix for one of the S Band antennas. There may be a problem here in that such an antenna protrudes prominently from the spacecraft, and this may make for more difficult interfacing to the Ariane 5 launcher. A more desirable antenna for S Band would be a patch array. That array may need to be of an etched circuit board design as opposed to the *air design* arrays used on U and L-bands.

Not shown are any provisions for omni-directional antennas needed at times on such a mission. This could possibly consist of single patch antennas or some kind of $\lambda/4$ wire antenna. Stiff wire antennas sticking out of the spacecraft would again address the issue of *things sticking out* and possible launcher interface issues. However, a U-band $\lambda/4$ antenna would only protrude some 172 mm and a L-band $\lambda/4$ antenna would only protrude some 59 mm.

All of these discussions notwithstanding, this proposed P3E spaceframe does afford a pretty nice piece of territory that can be used for the needed communications antennas. We need to wisely use this resource. Once the module complement of the mission is settled, the next large area of *discussion* would be that of antennas.

arianespace

ASAP 5 CONFIGURATION FOR TWIN AUXILIARY PAYLOADS



- ❑ **Maximum mass: 200 kg**
- ❑ **Volume: 800 mm for the height and 600 mm for the length x angle of 80°**
- ❑ **Maximum aggregate mass on ASAP 5:
4 A.P. x 200 kg = 800 kg**

ASAP 5.1
March 1999

Figure A5. ASAP Configuration for Twin Auxiliary Payloads. (Arianespace)

Power Generation & Storage

Shown in Figures 1 & 3 are solar panels populated with solar cells of the same size used on AO-40 (25x62 mm). They nicely fill the 400x520 mm panels with six strings of 19 cells. It would be planned to wire these cells into three strings of 38 cells, close to the arrangement in Phase 3D of 41 cells per series string. This provides a solar power supply of about 19 VDC that can be boosted to about the 28 VDC needed to charge the 20 NiCd, or preferably NiMH storage cells. It is also clear that we must strive to obtain the highest output (GaAs) solar cells that we can. This will be an expensive item.

The AO-40 auxiliary battery configuration is in mind for service in this P3E spacecraft as it has a high power density and a capacity of about 20 AHr. This is seen as a pretty robust energy storage method for P3E. A battery configuration of 20 cells was determined to be desired on AO-40 as it precluded any power buss voltages that would exceed 30 VDC under any conditions. This voltage boundary is needed to avoid any possible semiconductor damage due to device common rating limits starting at 30 VDC on many semiconductors. In P3E, it is planned that the battery cells would be grouped into assemblies of five cells per unit and mounted in the central cylinder of the spaceframe. Such a mounting will provide some useful latitude in achieving a proper spin-balance of the assembled spacecraft. This battery with its mounts (AO-40) will weigh about 11 kg.

All of this power operation will be controlled by an adaptation of the AO-40 battery charge regulator (BCR). The principles of the BCR go back many years to the earliest Phase 3 spacecraft, P3A, in the 1978-80 time frame. By keeping the same power buss voltage used on AO-40, we can avoid the need for any major BCR design change.

The solar panels themselves will involve a lot of the technology employed for AO-40, with some from AO-13. These panels are planned to be a honeycomb design of 400x520 mm with a core thickness of 6.4 mm (0.250 in.) and using 0.2 mm thick carbon fiber facesheets. The AO-40 panels were 675x1102 mm and 12.7 mm thick using 0.4 mm thick facesheets. This facesheet thickness was found to be much greater than needed, and the smaller panel reduces the facesheet thickness requirement even more. AMSAT experimenters are conversant with all of the technologies needed to produce such panels.

Conclusion

It seems obvious to me that creating the design of a P3E spacecraft is mostly a task of marrying much of what is already known and bringing that to a new spaceframe configuration. Approaching such a project in this manner can ensure that it can be done in a reasonable amount of time and for a reasonable amount of funds. Probably the largest uncertainty is that of finding workable conditions for an interface with the Ariane 5 ASAP5 platform.

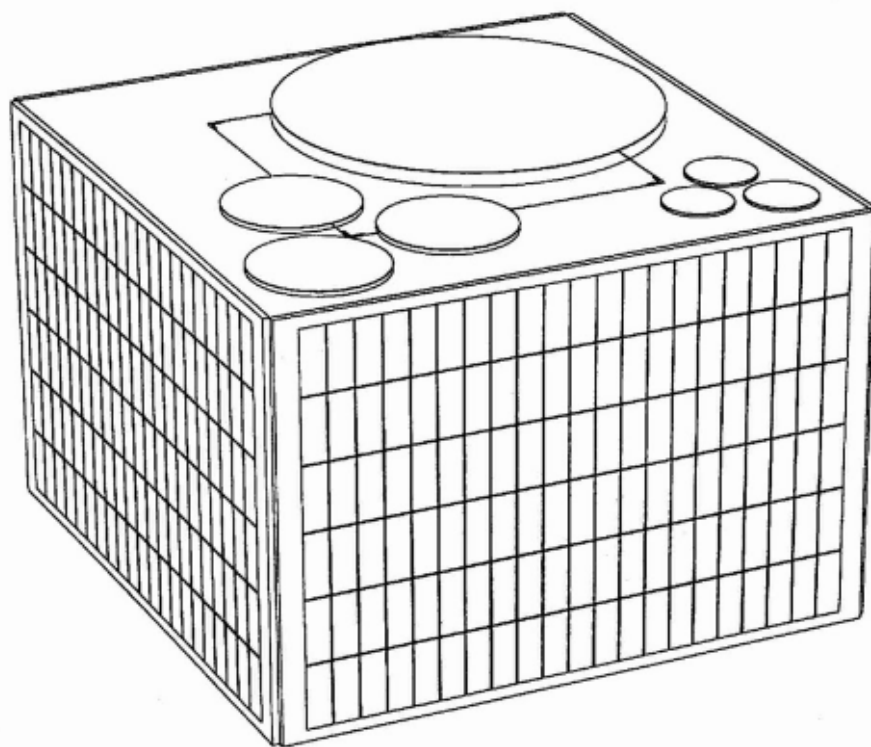


Figure A6. Simple Box Structure - 600x600x400mm.

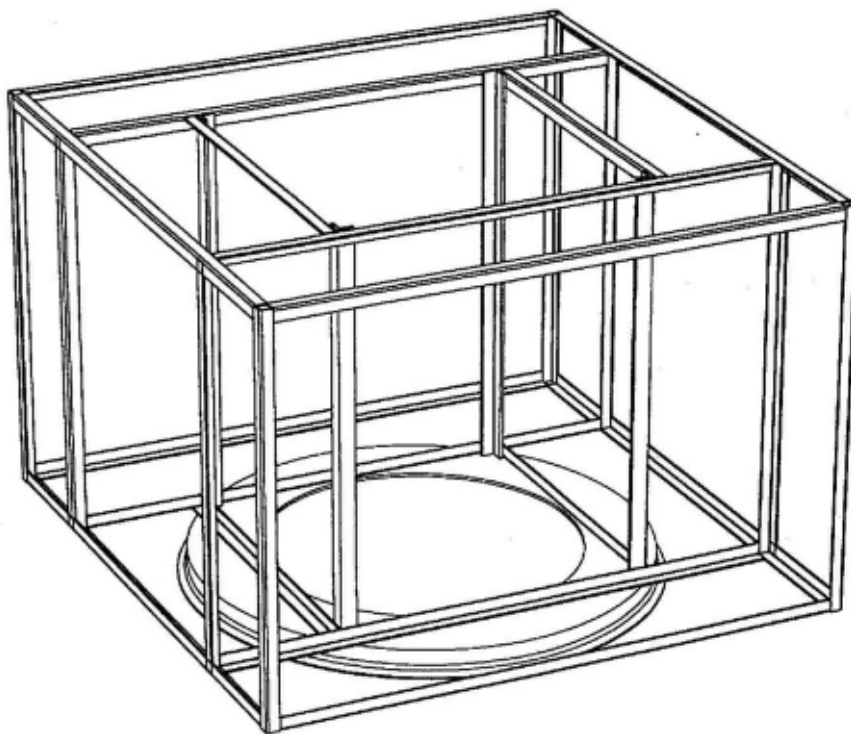


Figure A7. Interior View of Simple Box Structure.

Alternate Configurations

Since the writing of this paper, new information has been made available regarding payloads mounted to the ASAP5 platform. Figure A5 shows the platform of payload volume attachment to the ASAP5 platform. This shows that payloads will be fitted to the platform on a $\phi 3355\text{mm}$, or $R1677.5\text{mm}$ with an envelope maximum of $\pm 300\text{mm}$ of that radius, and a maximum height of 800mm . Interestingly, the first use of the ASAP5 (AR507, mission V135) was with payloads that exceeded some of these dimensions with the STR satellites being $700 \times 700 \times 700\text{mm}$. These dimensional restrictions would rule out the configuration shown earlier in this paper.

If we consider a simple box structure to fit within the maximum dimensions, a configuration such as shown in Figure A6 could be conceived. This shape has dimensions of $600 \times 600 \times 400\text{mm}$ and could have an internal structure as shown in Figure A7. The power generation of this configuration is a bit restrictive for good GTO transmitter performance, with only 114 solar cells of the AO-40 size, $25 \times 62\text{mm}$, on each of four panels with a BOL, $\beta = 0^\circ$, power generation of only 50.5W , $\eta = 15\%$; or 60.6W , $\eta = 18\%$.

Now it is confession time. The potential antenna configurations shown up to this point are not workable. Because of the low inclination of this GTO orbit, and that the spacecraft spin axis needs to be nearly perpendicular to the orbit plane, the antennas shown would mostly point into space and bypass the Earth. That is not a very efficient use of the RF power. Doing electrically de-spun antennas is a yet-to-be-achieved pipe dream. The only real solution for these smaller class satellites would be for the top of the satellite, or the antenna side, to be pointed toward the Earth at apogee, as was AO-13. Then we would have some decent DX performance from the satellite RF systems.

Let us solve the spacecraft antenna problems, along with finding spaceframe configurations that would be able to generate sufficient power to support the transmitters that we desire for this mission and also fit the ASAP5 platform. In that direction, suppose we look at a different configuration that would maximize the use of the available ASAP5 volume. These concepts will produce some *funny looking shapes*, but don't laugh too soon, as there is some potential here. Figure A8 shows a $984 \times 772\text{mm}$ box structure that is 460mm high. The launch attachment fitting is shown on the side, so the satellite would *stand on edge*. This configu-

ration would cause some considerable mechanical engineering study, but it is workable, just different. The spacecraft mass will need to be centered over the launch attachment, however the inherently stable spin axis, shown with the arrow, is perpendicular to the launch axis. So once this satellite is launched, the command stations will need to tip the satellite over, but that is just some activity with the magnetorquers. The spin axis would point to the Earth, and there is a nice space for antennas to be mounted to the top surface. **The antenna configuration shown earlier in this article would now be very usable for the satellite configuration shown in Figure A8.** The side solar panels are held down to the sides of the spacecraft for launch, but would be deployed as shown. This type of solar panel configuration would provide good power generation regardless of how the spinning spacecraft is pointed. Not shown is a solar panel that completely covers the spacecraft side that is opposite to the side with the launch attachment fitting.

The power generation of this latest

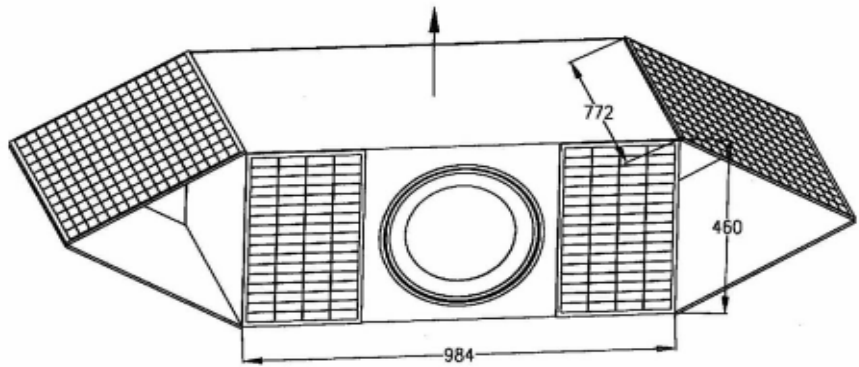


Figure A8. 984x772x460mm Structure.

configuration shows that for BOL solar cells a power of:

$$\begin{aligned}\beta=0^\circ: & 91\text{W}, \eta=15\%; \text{ or } 109\text{W}, \eta=18\% \\ \beta=90^\circ: & 124\text{W}, \eta=15\%; \text{ or } 150\text{W}, \eta=18\%.\end{aligned}$$

These numbers are not too bad to work with, and a very capable satellite could be designed to work with them. Power generation studies will have to be done for all other solar orientations, but that is just a matter of doing. ■

Orbital Elements by Ray Hoad, WA5QGD

Satellite	AO-10	UO-14	FO-20	RS-12/13	RS-15	FO-29	AO-27	AO-40
Catalog Number	14129	20437	20480	21089	23439	24278	22825	26609
Epoch Time	1022.05333062	1025.22868224	1024.79592753	1024.92954467	1022.83615210	1025.23150427	1024.90101066	1018.53756618
Element Set	742	607	301	318	516	388	894	28
Inclination	26.6497	98.3829	99.074	82.9208	64.8128	98.5674	98.3759	5.9258
RA of Node	290.409	90.5324	119.9514	21.2746	185.2527	269.6871	79.3449	230.0726
Eccentricity	0.5994877	0.0010214	0.0539901	0.0027628	0.0166868	0.0351369	0.0008366	0.813356
Arg of Perigee	119.9106	282.3212	273.8239	227.3018	251.7621	12.3056	335.278	208.4998
Mean Anomaly	312.5536	77.6827	80.1319	132.5816	106.5058	348.6399	24.8003	11.7742
Mean Motion	2.05862479	14.30625162	12.83286147	13.74245956	11.27539615	13.52756662	14.28329702	1.2692267
Decay Rate	0.00000055	0.00000225	-0.00000013	0.00000097	-0.00000043	0.00000009	0.00000212	-0.00000163
Epoch Rev	13243	57461	51370	50013	25027	21931	38212	99
Satellite	UO-11	AO-16	DO-17	WO-18	LO-19	UO-22	KO-23	IO-26
Catalog Number	14781	20439	20440	20441	20442	21575	22077	22826
Epoch Time	1025.89831196	1024.77623343	1025.24309206	1025.43290366	1025.70211441	1025.20584997	1024.89643483	1025.66410716
Element Set	404	405	399	415	406	119	58	884
Inclination	98.0138	98.4247	98.4368	98.4332	98.4431	98.135	66.086	98.3777
RA of Node	351.5426	97.5648	100.3552	100.1442	102.238	47.0944	266.1022	80.8083
Eccentricity	0.0011553	0.0010833	0.0010611	0.0011209	0.0011505	0.0006628	0.0015853	0.0009443
Arg of Perigee	105.7841	288.773	285.914	284.0095	283.3741	250.4164	268.1344	332.728
Mean Anomaly	254.4644	71.2254	74.0873	75.9842	76.6156	109.6308	91.7858	27.3411
Mean Motion	14.73343262	14.30730981	14.309359	14.30825707	14.30969748	14.38001361	12.86358664	14.28492402
Decay Rate	0.00001987	0.00000275	0.00000306	0.00000267	0.00000294	0.00000441	-0.00000037	0.00000238
Epoch Rev	90508	57457	57469	57471	57479	49982	39723	38226
Satellite	KO-25	TO-31	GO-32	SO-33	PO-34	SO-35	UO-36	AO-37
Catalog Number	22828	25396	25397	25509	25520	25636	25693	26065
Epoch Time	1025.70727217	1024.91047923	1024.89077366	1025.55460112	1024.76086727	1025.84235832	1025.79366135	1025.52895132
Element Set	866	473	484	225	283	400	502	136
Inclination	98.3752	98.702	98.6986	31.4446	28.4605	96.4559	64.5618	100.1954
RA of Node	81.0505	103.9417	103.5615	84.4839	186.3699	181.951	151.7286	293.5672
Eccentricity	0.0009953	0.0004203	0.000147	0.0363033	0.0007088	0.0151423	0.0049938	0.003751
Arg of Perigee	312.9984	146.5701	143.9949	208.9949	125.0064	197.2028	265.5983	247.8972
Mean Anomaly	47.0363	213.5745	216.1326	149.0067	235.123	162.4033	93.9427	111.8225
Mean Motion	14.28911862	14.22886774	14.22533034	14.25381352	15.0744144	14.41682531	14.73574053	14.34473261
Decay Rate	0.00000279	-0.00000044	0.00000134	0.00001221	0.00003209	0.0000118	0.00001034	0.00000373
Epoch Rev	35044	13218	13218	11757	12333	10116	9510	5223
Satellite	OO-38	WO-39	SAUDISAT	TIUNGSAAT	SAUDISAT	OCS	MIR	ISS
Catalog Number	26063	26061	26545	26548	26549	26062	16609	25544
Epoch Time	1025.71851962	1025.53646233	1025.12708203	1024.48956299	1024.92957917	1025.55146680	1025.86159722	1025.79700238
Element Set	139	166	66	67	70	467	486	552
Inclination	100.1947	100.1934	64.5579	64.5594	64.5529	100.2173	51.6462	51.5752
RA of Node	293.7734	293.8426	183.279	184.5514	184.4075	308.5683	191.3062	88.4581
Eccentricity	0.0037449	0.0036028	0.0016561	0.0016055	0.0017878	0.0007164	0.0015429	0.0009666
Arg of Perigee	245.3793	245.8093	20.0948	359.9418	37.3382	126.8974	282.9653	33.3382
Mean Anomaly	114.3504	113.932	340.0829	0.1652	322.8959	233.29	241.9981	74.2978
Mean Motion	14.34532877	14.3528265	14.74910748	14.76144159	14.73994005	14.98912196	15.91993625	15.69417581
Decay Rate	0.00000365	0.00001023	0.00001971	0.00002258	0.00001485	0.00395345	0.00085817	0.00046311
Epoch Rev	5226	5226	1779	1771	1776	5298	85426	12481

Burbank School Makes First ARISS SAREX Contact

Charlie Sufana, AJ9N

Here's the Burbank School recipe for an ARISS SAREX contact:

Ingredients:

- 24 hours of total set up time mostly in subzero wind-chill temperatures,
- 2 or more feet of fresh snow,
- 600 feet of coax,
- 4 radios,
- 3 antennas,
- 2 power amps,
- 5 power supplies,
- 2 phone lines, and
- 2 un-interruptible power supplies.

Add:

- A few hundred trips by the crew up and down a ladder to the roof,
- 800 feet of video cable for 5 TVs,
- 250 feet of phone line, and
- 150 feet of cable for the public address system.

Mix in:

- 14 happy students,
- 1 very organized teacher,
- 1 elated principal,
- 200 excited and proud students and guests, and
- 1 happy ham crew.

All of this equals one successful Amateur Radio contact with Bill Shepherd, KD5GSL operating NA1SS on board the International Space Station Alpha. The Burbank School of Burbank, Illinois is very proud and honored to be the first SAREX school contact with the International Space Station. Are we having fun yet?

School Background

First a little background on Burbank school and their activities. Burbank School is an elementary school located in Burbank, Illinois, a community located on the southwest side of Chicago. The school has a population of 700 students.

Rita Wright, the teacher who organized the Burbank School's portion of the ARISS SAREX efforts describes what was happening at the school leading up to the big day:

Since being notified of our ISS contact, our

teachers and students were very busy with space, space station, and space exploration topics and activities. Here were just a few things going on at our school:

Our entire school population participated in a school-wide art contest involving the creation of our Burbank School/ ISS mission patch.

We held auditions for our team of 12 students with 2 backup students resulting in students from a cross-section of classes.

For our questions, we again turned to our students, school-wide and were surprised at the quantity and quality of questions received. If you walked into our school today and wandered down the halls, you would be surprised at the variety of topics, activities, and displays of work all centered around the ISS mission. Our school is vibrating with excitement and activity.

Our first graders have been creating space people and space capsules. Their themes are Flying High is Grade One and Adventures in Space. Their bulletin boards reflect the imagination and creativity only a first grader can have. They even have Winnie the Pooh in a space suit! As you walk past classrooms, you can hear students and teachers alike talking about space, shuttles, space stations, and what the latest information is about the ISS.

Second graders wrote stories about why they would like to be an astronaut and then made space shuttles out of empty Pringle cans. They colored pictures of astronauts and put their own photograph on their helmets. Some built space communities of the future and created robots that will perform city services. They even wrote laws for their community. One of our classes created the Cosmic Café with menu items such as Lift-off Lemonade, Space Station Steak, and Pluto Pudding.

Students in the middle grades were busy imagining they were astronauts working on the space station. They wrote their own biographies and included future missions they would like to be involved with. They tracked the ISS on the web and plotted on a map where the space station was every 45 minutes. They wrote time lines comparing our school day to the ISS. Other children wrote poems and made chalk drawings to accompany their poems.

To prepare for our ISS contact, the junior high students searched the web for information on the space station. After much discussion, the students created PowerPoint® presentations. They made a ten-slide show, which consisted of one slide telling what the ISS is, one slide for the astronaut, and one for each cosmonaut on the ISS, the remaining slides contained information about space and the space station. Students are prepared to present this to our audience on the day of the contact. The PowerPoint® work was prepared by our Special Education students in junior high.

Other junior high classes worked on creating a NASA time line. In Math, students used the distance formula to calculate the ISS distance from us here in Burbank. This was done over a period of several days so students understood the idea that the ISS was constantly moving. In addition to measuring distance, students also considered time. They thought about their own future and where they would be in the year 2030. By then we will need a new ISS, so some of our future engineers decided to design and build the space station of the year 2030. They not only built the model, they also wrote a paper describing how and where it will be built. Our more artistic students decided they would be scientists on the new space station. They proposed that they were assigned to gather information using a new high-powered telescope. They then used their creativity and imagination to draw what they saw when they looked through the telescope. Some of our students are very interested in the environment. They decided they would research and write a paper describing a particular man-made Earth pollution problem. They then would develop a plan for solving the problem using the technology of the space station.

All classes spent time using many of the websites that Charlie Sufana, AJ9N, our Amateur Radio coordinator, shared with us. As our students continued their search, one site led to another and their enthusiasm grew proportionately.

The kids at Burbank School were indeed having fun. Repeating, as Mrs. Rita Wright put it, "If you walked into our school today and wandered down the halls, you would be surprised at the variety of the topics, activities, and displays of work all centered around the ISS mission." She also said, "our school

is vibrating with excitement and activity.”

It's Perfect Weather to Put Up Antennas!

Our ARISS SAREX ham team was also vibrating with excitement and activity. We started our radio set up on Sunday, 10DEC00, at 1000 HRS. Setup meant we carried 12 concrete cinder blocks, five 35-pound sandbags, 4 sheets of plywood, 2 tripods, and 2 antennas with their associated azimuth and elevation rotators, control cable, and coaxial cable to the roof of the 2-story school. All of this was done with about 10 inches of snow on the roof and the temperatures at the start of the day at about 34F° and falling, wind-chills at times during the day were about 0F°, and after eight hours we were done. The temperature at that point was about 20F°. However, despite the temperatures, our ARISS SAREX set up actually went fairly well. The plywood was used to protect the roof and the tripods were screwed into the plywood. The heavy weights comprising of sandbags and cinderblocks were used to keep everything on the roof. The antennas went together easily. Field soldering was done on the roof when we had to repair the backup antenna's rotator control cable. Everything tested out as OK and we battened down the hatches for the predicted heavy weather coming in the next day. Bottom-line; perfect weather for putting up antennas! Because of the layout of the school, we had to unhook all of the cables at the ground end and store them in plastic bags for the next setup day.

The next week and a half were a kind of blur ~ the snow kind. The Burbank was hit with two full-blown blizzards and four additional snows. Temperatures were mostly in the 20°F range and usually had below zero wind-chill factors. Meanwhile I would get daily reports from the school on the status of our equipment, or I would stop by to see if everything was still in one piece.

On the Monday, 11DEC00 blizzard, the practice session with the students is canceled. Two days later, during the Wednesday 13DEC00 blizzard, I arrive late to hold practice with the students after a three-hour drive that should only have taken 45-minutes. After the students left, Bob Mocek, Burbank School Principal and I tested the telephone extension cables and the public address extension cord that I had constructed and installed. As a result, I got home about 2300 HRS.

Number 2 setup day was scheduled for Sunday, 17DEC00 and started again about 1000 HRS in which we installed all of the power supplies, computers, power amplifiers, au-

dio equipment, SWR meters, radios, and hundreds of feet of cable. Later we held a full-scale test and in the gym. Contact day was scheduled for 19DEC00 which was two days and counting. Setup, while somewhat technical, went good and we only had a few glitches in the audio system. We ended the day thinking we had everything workable. Once again, we had to disconnect all of the cables going outside so that we could close the door to the gym.

Contact Day: 19DEC00

Our ARISS SAREX contact day started early at 0800 HRS with our arrival at the school after another night of snowfall. The contact time was scheduled for 1459 CST and we had to re-hook up all of the cables and get everything into place. The gym gets turned into a hall with chairs placed wall to wall to accommodate all of the expected viewers Figure 1). The overflow crowd was put into the school cafeteria to watch the action on television media, the mayor, and a congressman were all there. At approximately 1459 CST (2059 UTC) we gave our first call to NA1SS. We called, and called, and called. We were only able to hear bits and pieces from Bill Shepherd and were never really able to establish contact. We made a second attempt one orbit later that was also unsuccessful, as it appeared that the crew had indeed gone to bed.

What Happened?

After these two attempts, we met to discuss what could possibly have gone wrong on with our attempt. In re-checking the equipment it was discovered that the microphone gain control on the Yaesu FT-847 was at the nine o'clock position instead of being up at the 1 or 2 o'clock position. It was later confirmed the next night via test that the 9 o'clock position is right on the line between having or not having audio. The crew reported via a conversation with W5RRR at the Johnson Space Center on Wednesday 20DEC00, that they heard some carrier but no audio. During that conversation with W5RRR, the crew agreed to another attempt on Thursday 21DEC00.

We rechecked our antenna alignment, rotator control operation, and power output of the amplifiers to see if there anything we missed. It was probably our fault with not re-checking the microphone gain control right before the contact since we had tested it earlier in the day.

Contact Day: 21DEC00 - Another Attempt

Thursday, 21DEC00 was our new contact day. Guess what? The night before brought more snow, winds, and temperatures of 13°F! The strong winds had changed the azimuth on the primary antenna so that was realigned; two days earlier the antenna was at a 0° azi-



Figure 1. A large crowd assembled in the Burbank School gymnasium for the ISS SAREX contact.

moth; after the storm, the antenna was pointing at 40°N. However, at 20:28 UTC, Bill and the ISS came up over the horizon for what turned out for us to be a nearly direct overhead pass. Connection was made within seconds of AOS and continued right up to LOS at 20:39 UTC. Once he broke into the clear, the signal was essentially full quieting. The contact was going so well that all 14 students had their questions answered and one student got to ask an additional question. Furthermore, Rita Wright, the organizing teacher was able to express her thanks to Bill and the crew. I even asked a question that the students were afraid to ask while we searched for another student question!

Transcript of the Contact

AJ9N: NA1SS, AJ9N. Burbank Illinois on schedule

KD5GSL: AJ9N, NA1SS.

AJ9N: NA1SS, AJ9N. Let me try to get you in a little bit better Bill. Go ahead give us some talk. And greetings!

KD5GSL: Alpha Juliet 9 November, NA1SS we have you readable. Go ahead.

KD5GSL: AJ9N this is NA1SS Alpha Space Station. Flying up over Texas right now. We're about 200 miles up. We have you readable, but please speak a little bit slower.

AJ9N: OK Bill, we've got you right down the pike right now. Our first question is coming in from Jessica.

1. Jessica Lehocky, 7th grade: What emotions did you feel as you boarded the Soyuz rocket?

KD5GSL: Jessica you're a little broken. I think your question was what emotions did I feel when I got into space? I'll tell you after

an eight and half minute ride on a big rocket you feel really relieved to be in outer space.

2. Kurt Susniz, 8th grade: Since being in space, what has been the hardest adjustment?

KD5GSL: Kurt, I guess the hardest adjustment about being in space is everything is really easy. You can move around with just 2 fingers pushing off the walls, float all the way across the whole space station. So the hardest part about being up here is just trying to go real easy when you move around. How is that?

3. Ivona Karpiel, 5th grade: What is the most important thing that is recycled in space? How do you do it?

KD5GSL: Ivona, the most important thing we recycle in space is water. Humans put out a lot of vapor, particularly when we exercise and we have a little air conditioner that takes that water out of the air and condenses it. We basically put that through a processor and we drink it. So about 90 percent of the water that ends up in the atmosphere gets recycled and that's very important because water is very heavy.

AJ9N: OK, Bill very good. By the way, the handle here is Charlie.

4. Ashley Ocuera, 7th grade: Who inspired you to become an astronaut?

KD5GSL: Wow, that is a pretty good question. My dad was a pilot in the military, he flew in the Navy and my grandfather was a pilot in the Army in World War I in France. So I was always interested in aviation. So I guess that's where I got my interest in being an astronaut.

5. Brittany Lukasik, 1st grade: What do you and the cosmonauts do in your spare time?

KD5GSL: Brittany, well we have a lot of cameras. We look out the window and take pictures of the world. And it is very interesting from space because you can see things that you can't see from the ground. We also have e-mail, we write friends and family at home. We have some games and we watch a few movies once in a while. We watched Mel Gibson tonight in *Lethal Weapon*.

6. Keith Taddei, 7th grade: Were you able to vote in the presidential election? How did you do it?

KD5GSL: I am a military guy Keith, so I can vote from the state where I am a resident, which is New York, and I can do it by ballot so I mail it in even before I take off. We do have a process on board where you can vote electronically, although I did not use that on

this flight.

7. Brittany Cook, 5th grade: Do you have any advice for young students who might want a career in space exploration?

KD5GSL: Boy I sure do, that's a great question. I'd just like to say that there are probably only a few people who will be astronauts or cosmonauts. But there are tens of thousands of people who work on this team that we're on and they're all interesting and important jobs. So just because somebody says, well you know you don't, the chance of being a cosmonaut or astronaut is really low does not mean that should not stay in school, do well, and study science and math and those things that are going to make you a real contributor to the space program because there are just hundreds of things you can do as well.

8. Christopher Bogue, 8th grade: Describe how you felt the first time you saw Earth from space?

KD5GSL: Christopher another great question. I felt when I looked at earth, this was in 1988 my first flight on the shuttle, I felt, it was in the winter, kind of like this time of the year, I looked out over Russia. And I thought I was looking at the surface of another planet. It occurred to me at that time why, why not, why could this not be the surface of someplace like Mars. And I think that's a question we ought to go answer.

8. Dan Coughlin, 8th grade: Since you have been in the space station, what improvements have you made?

KD5GSL: Well, Dan, we put a lot of equipment in. We put 2 air conditioners in. We installed a lot of the CO2 removal system that takes the carbon dioxide out the air. All kinds. We built a table out of spare parts. We've done all kinds of work up here. It's a long list.

9. Alex Bandyk, 5th grade: Do you think that you are a role model for kids and if so, how do you see your responsibility?

KD5GSL: I think every astronaut is a role model for kids. And I think the influence of the space program has on education is a strong one. I just hope that we continue and you know try and tell people on the ground what we're doing up here and why it is important. Because some day you folks are going to grow up and you're going to be voters, taxpayers, and you might even be part of the space program. So it is very important that you know what we're doing.

10. Candace Field, 5th grade: What is the one thing you will always remember about

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being on the International Space Station?

KD5GSL: The one thing that I always will remember about being on the space station is all the folks that I get to talk to on the ground. And the great stories that we can tell back and forth about what we are doing. For me, I think that's one of the best memories that I think I will have for a long time.

11. David Valdez, 2nd grade: *Who controls the Space Station when all of you are asleep?*

KD5GSL: David, that's an excellent question. We have 2 control centers; one in Moscow, one in Houston. They're watching the station all the time. And they basically pass control of the station from one country to another when they're on different parts of their shifts. And right now we're being controlled from Moscow. They're watching us night and day.

12. Athena Weimer, 8th grade: *If you could put something in a time capsule for future generations, what would it be?*

KD5GSL: I'm writing a series of logs every day on what we do on space station to try and give people on the ground some idea on what life is like up here. I would like to see that maybe stored for future use by people who want to know what we did maybe in the future.

13. Eddie Vale, 7th grade: *What is the least and most favorite thing about being on the International Space Station?*

KD5GSL: I think the most favorite thing about being on space station is just the ability to float around in space. It's like you're not moving at all. You're just like in a pool and could move anywhere you want but there's no water in it.

14. Charlie Sufana, AJ9N: *OK real good Bill. The kids all have this one question but nobody wants to ask it. I'll ask it. How do you go to the restroom?*

KD5GSL: Well, actually the toilet up here works very well. It's a lot like you'd have on a camping trip, a camper, or maybe on a boat out at sea. And it's something the Russians have designed. It has been working well for us now. And I'd say it is one of the better systems that we have on board.

AJ9N: Real good, now we've got the teacher Mrs. Rita Wright. I've put her on the spot.

15. Rita Wright: *It isn't a question; it's actually a big thank you for doing this for the students of Burbank School. Thanks a lot.*

KD5GSL: Well it's a great pleasure to talk to

all of the folks down there. Hey, Rita I've put your letter out. To me it is one of the finest examples of why we have a space station, what the meaning of the space program is for kids. So don't be surprised if several hundred thousand people have already read your letter. I thought it was fantastic.

AJ9N: We're about a minute 30 out. We've got one question real quick? We've got one. Go ahead Jessica.

16. Jessica Lehocky, 7th grade who got to ask a second question: *Can you tell us any place you can see right now?*

KD5GSL: Well, right now I'm in the middle of the module called the functional cargo block (FCB) and we don't have any windows that I can look out. We had a pass right before this; we went up the East Coast of the United States, just a little bit offshore. You could see about 600 or 700 miles out the window in any direction. And we could see from South Carolina to about Virginia, you know, in one glance, when you glance out the port-hole.

AJ9N: Real good Bill. Now we're under a minute out. I don't want to lose you in mid-sentence. So we would like to say thank you. Thank you for coming back on the second day.

All Students: 73 from Burbank School NA1SS, AJ9N (Figure 2).

KD5GSL: AJ9N November, NA1SS. Really enjoyed doing it and looking forward to doing

a lot more of this with kids around the country. It's been a real pleasure. Thanks

AJ9N: Well thank you much. Godspeed!

KD5GSL: OK Alpha Space Station carrying on. Thanks again for the contact. And AJ9N NA1SS

Are we having fun yet? I think we were able to finally say "Yes!"

After the contact, we had many parents and students thank us for staying with it. Our group thanks all of those who came back.

A School Principal's Perspective of the Event

A few days after the contact, I received the following from Mr. Robert Mocek, the school principal. It may be best comment I have received so far.

Rita Wright's letter pretty much summed up what the school did to make the contact an interdisciplinary learning experience for all grades across a variety of academic concentrations that included math, science, reading writing and art...Howard Gardner would be proud of us for engaging multiple intelligences. Making the contact such an experience is a must for others who follow because the transformation that took place was quite revolutionary. We came closer together as a school. Teachers who might otherwise have stayed in their own worlds didn't. They wanted to be part of the experience. Junior high students who ordinarily trudge their way



Figure 2. Burbank students thank Bill Shepard, KD5GSL for the ARISS SAREX contact.

to school day in and day out hardly taking time to say hello were walking in to school talking about why they thought the experiment failed the first time. Because of this event they dropped the *rules of cool* and showed interest and, God forbid, excitement about school subject matter. Parents pitched in and helped because they sensed how special the event was and because they genuinely wanted to be a part of it. The community at large read about us in the papers.

As for the future, I'm not certain exactly what will come next though I will discuss that with Rita Wright and Sue McNichols. I am certain, however, and pleased to report, that the event changed me as an educator. Now I have a much better appreciation of how important it is to knock things off center, to think, even leap, outside the box on occasion. Granted we won't climb up on the roof and construct antennas in subzero wind chill again soon (Oh, I hope not), but we might think differently about installing connections for them when and if a new junior high gets built in District 111. And really, *thinking differently* is the essential benefit. The other day I saw a Ford ad featuring a prototype of a hydrogen-powered car, and I thought why not invite Ford and the car's chief designer to our school for a test drive. If Burbank hadn't had the contact, I know I would have just turned the page.

The excitement of the event will fade in time, but some of the changes will endure to our

benefit. I'd be delighted to talk to any others who you know are planning future communications and help them in any way that I can. I hope I answered your questions.

The Equipment Used

For those who are interested, the equipment consisted of a primary and backup station (Figure 3). The primary station was a Yaesu FT-847 driving a RF Concepts RFC2-315 driving 150 watts through 200 feet of 9913 flexi-coax to a Cushcraft A144-20T beam sitting on top of a Yaesu G5400B azimuth and elevation rotator. The backup radio was an Icom IC-746 driving a Mirage 150 watt amp that was connected via 150 feet of 9913 and 9913 flexi cable to a Ringo Ranger with a Cushcraft A144-10T beam on top of an AR40 azimuth rotor and U100 elevation rotor that had 200 feet of 9913 coax as standby. All of the power supplies except for one were Astron. We also had two Yaesu FT-290R II radios for backup. The primary radio, computer, and rotator controls were all on an uninterruptible power supplies fed from different AC power circuits. NOVA satellite-tracking program was used for antenna aiming. Rotator control was done manually as we could never get the Uni_trac controller to work properly with NOVA. I might mention that we had absolutely no coax cable problems in spite of the heavy weather.

Thank You, Thank You, Thank You

As with any major undertaking, help is greatly needed. The following hams are to be thanked for their assistance: Ken Brown,

KE9TC; John Giannotti, W9WY; Ron Grams, WB9IMR; Ron Kay, KB9UQG; George Kelly, K9WWT; Doug Kiser, KD4CXG; Kevin Krikau, KB9THY; Chris Laub, N9KNT; Mal Lunsford, W9MAL; Bryan Majoch, W9ZRO; George Masek, KB9UNA; Mark Skowronski, K9MQ; Gerry Swanson, N9MEP. KE9TC, W9WY, K9WWT, KD4CXG, KB9UNA, K9MQ, and myself put in long hours on the roof. We also enjoyed having some of the parents help out. We wish to thank Denise and Mike Taddei for helping out each day; perhaps, we will have some new hams joining the ranks.

We also must thank Rosalie White K1STO, Jennifer Hagy N1TDY, and Rick Lindquist N1RL at the American Radio Relay League. We especially wish to thank AMSAT, Frank Bauer, KA3HDO VP for Manned Space Flight and ARISS Chairman and Will Marchant, KC6ROL. At NASA, we thank Debbie Brown.

At Burbank School, we thank the principal Mr. Robert Mocek for letting us in his building. We thank Mrs. Rita Wright for her diligence and interest in keeping this project going and we thank Mrs. Sue McNichols for her assistance.

This contact was also put on the World Wide Web by MSNBC. We thank Miles Mann, WF1F for getting us in touch with them. At MSNBC we greatly thank Alan Boyle, William Cooper, David Mahlum, William Geer, Jennifer Loomis.

We thank the follow hams who provided us audio files or tape so that we could re-mix our downlink audio: Stan Olson, KB9YBU; Al Lark, KD4SFF/N4ISS; Mike Thompson, WB8ERJ; Bob Anderson, W8KZM; and Ken Groom ZR5AAD/W8.

In closing, the Burbank School students and ham crew really wish to thank Bill Shepherd, KD5GSL and his crewmates Yuri Gidzenko and Sergei Krikalev for allowing us to spend a few minutes of their valuable time in having this exciting conversation. I believe the students will remember this day for a long time. ■

For additional information on this ARISS contact see:

<http://www.burbank.k12.il.us/Schools/Burbank/newsletters/iss/>

<http://www.arrl.org/news/stories/2000/12/22/2/>

Also contact Rosalie White, K1STO (k1sto@arrl.net) for ARISS school applications.



The Phase 3D Launch Campaign: A Photo Essay from Kourou - Part 2

Dick Daniels, W4PUJ



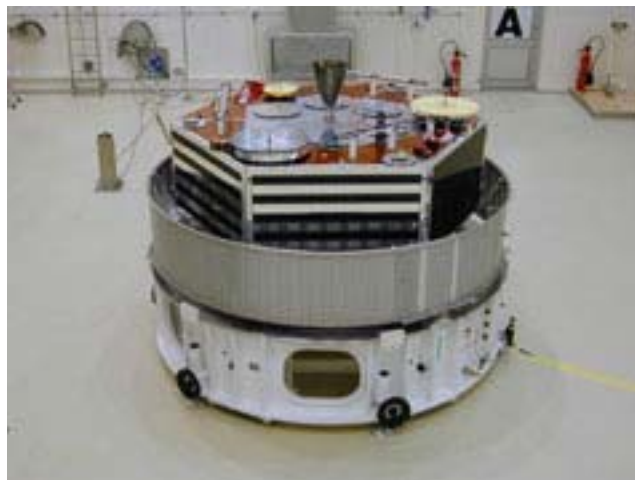
Here is Dick Jansson hard at work applying thermal protection material to one of the 70 cm patch antennas. In addition to thermal blankets on the top and bottom of the spacecraft, extensive use of thermal protection adhesive tapes were applied to surfaces to assure an optimum thermal balance in space.



Checkout activities completed, the spacecraft is buttoned up. Here Jay Ramdas is installing cover plates around the base of the 400 N motor.



After the solar panels have been installed and prior to fueling, the spacecraft is installed in the SBS carrying structure.



The Phase 3D spacecraft in the clean room, closed out, fully fueled and ready for integration into the payload stack.

AMSAT-UK 16th Colloquium - Call for Papers

The 16th AMSAT-UK Colloquium will be held at Surrey University, Guildford, Surrey, U.K., from 27 - 29 July 2001. Offers of Papers should be submitted as soon as possible; the final date for full documents to be received is mid-June 2001 in order that the proceedings are available to participants.

Submissions should be sent to Richard Limebear, G3RWL, via the following routes:

Internet e-mail: g3rwl@amsat.org

Postal mail: R. W. L. Limebear, G3RWL, 60 Willow Road, Enfield EN1 3NQ, United Kingdom. (no fax available)

AMSAT-UK also invites anyone with requests for program topics to submit them as soon as possible to G3RWL. Invitations for any papers on specific subjects will be included in the future call. Additionally, AMSAT-UK will be running sessions specifically for beginners to amateur satellite operating on the Saturday; volunteers are requested to speak to these sessions. Colloquium web pages are at <http://www.uk.amsat.org/colloquium.htm> or follow the link from the AMSAT-UK home page.

AO-40 Log

16 November 2000 - 01 January 2001

Editor's Note: From time-to-time, The AMSAT Journal will publish a log on AO-40 to chronicle the events of its commissioning and operation. Thanks to the variety of sources that provided input into this log.

20NOV00: AO-40 Status Report from DJ4ZC

1. AMSAT OSCAR 40 had a perfect launch on 16NOV00 and was injected into a nominal orbit.
2. Transmission of telemetry from AO-40 on 70cm was expected 3 hours after launch but we ran into a problem with the 70cm TX. Consequently the spacecraft was switched to use the 2m middle beacon as downlink for telemetry. This required a *repeater program* in IHU-2 that was uploaded.
3. After communication was established, the health of AO-40 was analyzed and everything testable at this stage except for the 70cm TX was found to be nominal and fine.
4. The attitude control system then was calibrated and torque operations were started to take the attitude to 270/0. This reorientation should be finished in a few days. Then we are ready for the first planned orbit change (400N-mtr) resulting in 50000 km apogee altitude. The attitude will also allow a thorough study of the 70cm TX problem with the high-gain antenna.
5. The two 2400 MHz transmitters were operated and are ok.
6. Pictures from the separation sequence are being downloaded and will shortly be available on our website. (*Editor's Note: Also see page 1 of the Nov/Dec issue of The AMSAT Journal.*) There we will also show the test-schedule for some first amateur operations.
7. Steps after first orbit change: test the electric propulsion system and then use it to further increase apogee altitude using the arcjet before the big inclination change. (**per Karl Meinzer, DJ4ZC via amsat-bb**)

23NOV00: News of an Orbital Path Maneuver

The first orbital path maneuver was announced in the past days; AO-40 will be put into a new flight attitude (ALON/ALAT 270/0), in order to carry out the first motor ignition. The plans are as follows:

1. First apogee increase to 50,000 km by ignition of the 400-N engine at perigee.
2. Further increased to 70,000 to 80,000 km by the arc-jet at the perigee
3. Increase of the inclination to 65° by the 400-N propulsion system and height reduction of the apogee

Viktor Kudielka, OE1VKW, who is authoritatively participating in the orbit planning for AO-40, has indicated, contrary to earlier announcements the stronger propulsion system will be engaged. "With two propulsion systems on board a satellite in the GTO and in the goals, to achieve a highly elliptical path with greater inclination and an orbital time of 16 hours, at an apogee, which will be located over the northern hemisphere for at least ten years, there are a large number of alternatives to consider, particularly if the total life is 20 years, and for the possibility that at the end there should be a safe re-entry, in order not to leave space junk in the environment. For the solid execution of the maneuvers the parameters of sun angle, energy balance, link budget, and fuel usage for the intermediate orbits must be considered. The major change in the inclination from 6° to 65° can be accomplished only with the energy from the 400-N engine."

"There is a relationship between the height of the apogee and the required energy for the increase in the inclination. In a higher orbit one can save fuel, and achieve a saving to achieve the higher orbit. Whether this is done before, during, or after the insertion of the arcjet propulsion, makes little difference. The advantages of a first firing of the 400-N rocket engine are:

1. We receive an accurate calibration of the engine and can plan the inclination maneuver more precisely.
2. In a higher orbit the change influences of the sun and moon are smaller on the perigee argument and the right ascension argument (RAAN). That simplifies the use of the arcjet engine, since changes of RAAN and the argument of perigee have to be corrected using flight maneuvers."

OK1VKW has proposed several alternatives for an apogee height of 58,000 km to 100,000 km for the inclination maneuver. The higher the apogee, the less energy is required for the increase in inclination. Project Leader Karl Meinzer, DJ4ZC, does not see any problems in the selected apogee height between 70,000 km and 80,000 km and attitude control or communications. In this higher and thereby longer orbital path more energy can be charged into the batteries, which the electrical arcjet propulsion engine will then need. (**via AMSAT-DL WWW Site**)

29NOV00: SH1-GB in Operation at Times and 400-PSK-Software and Unofficial Picture Collection

The beacon on AO-40 has communicated: Time period (MA20-26) the general beacon of the S band transmitter is in operation on 2400.2 MHz. The actual attitude of 260/-9 makes it possible to turn on the S band transmitter.

There is something available in the matter of demodulation. Two programs are now available, one a program of telemetry software P3T by Stacey Mills, W4SM. Nino Porcino, IZ8BLY, has released version 0.3 of his soundcard program. Dave Page has written a further program for demodulation of

the AO-40 beacon signals. Both programs function as Internet servers, which can be connected after the invoking of the proper IP address of P3-T. Both authors give information on their homepages:

<http://www.Iz8Bly.syonline.it/P3D>

<http://www.wind.dave-page.com/psk400/>

Tip: With each change of the IP address on P3-T before the next attempt at connection try the *TCP/IP off*. If the computer has had a network name assigned, this should be invoked. Both of these made it easier to make these not always free of problem connections easier at DL6DBN (W98, P-200).

A new program to demodulate the PSK beacon on AO-40 is available. Thomas Sailer, HB9JNX/AE4WA, has written a software program, which is available for several platforms (Win, Linux) including the source code⁴. Currently there is no logfile for the P3-T software available. Only shown are the CRC, a HEX dump and an ASCII dump: <http://www.ife.ee.ethz.ch/~sailer/ham/p3d/>

In the meantime there is also telemetry beta version software for Apple/Mac. It is unfortunate that the author team could not test it: www.goldensquare.net/MacTLM/MacTLM.sit

Paul Willmott, NP9MU, has been collecting the contents of the D blocks from the beacon transmissions from AO-40. With the aid of the logged data from other stations he has been able to decode several pictures. Mark Hammond, N8MH, has put them into an unofficial picture collection. An official collection with commentary of the best photographs with valuable content will appear in the next few days at <http://www.camel.campbell.edu/~hammond/ham/p3d/images/> (per Frank Sperber, DL6DBN via AMSAT-DL WWW Site)

30NOV00: S Band Signals Heard in DL

As expected the S1 transmitter with the general beacon (GB) turned on today at 9:08 UTC at MA 20. The 2-meter beacon ran along in parallel. The signal was received on 2400.180 MHz because of the high Doppler shift. In spite of a large squint angle and a less than optimal right polarized signal a (S+N)/N of around 6-7 dB on a 60 cm reflector and a total noise figure of the system of about 2.5 dB was received at DL6DBN. The signal was accompanied with a strong shifting of about 200 Hz in rhythm with the spin and is caused by the saturation of the coils of the S band transmitter during the magnet torquing. At MA 26 at 0924 UTC the S band transmitter was silent again. The attitude correction is continuing to proceed. In the meantime the sun angle is 24 degrees and the spin rate is 6.6 revolutions per minute. The energy budget to put the S band transmitter into operation with the engineering beacon (EB) beginning tomorrow between MA15 and MA26. (**per Frank Sperber, DL6DBN via AMSAT-DL WWW Site**)

05DEC00: AO-40 Status

As of 04DEC00, current spacecraft attitude is ALON/ALAT 267/-3, which is one step closer to 270/0 for the first engine-burn. Spin-stabilization has been increased to 7.6 rpm. S2 Middle-Beacon around 2401.335 MHz +/- Doppler is on between MA 16 and 26. Signals on a 60-cm-dish were 18 dB (S+N)/N this morning. (via AMSAT-DL WWW Site)

10DEC00: RUDAK Powered Up

RUDAK-A has been turned on successfully. Command stations could get contact and the system could be heard with 9k6 bps FSK on 2401.747 MHz Doppler while S2-TX was on. During the next days the operational software should be uploaded. Besides providing packet-radio service. RUDAK is key to experiments like SCOPE, GPS, CEDEX and RF-Monitor. Frequencies can be changed while commissioning without announcement: RUDAK-A 2401.747 and 2401.720 - RUDAK-B 2401.867 and 2401.847 MHz. S2-TX is now on MA 16-30.

After another IHU-2-crash on 08Dec00, AO-40 is back well and progressing to the first motor burn. Stacey Mills, W4SM of the AO-40 command station, stated that these crashes aren't serious, as IHU-2 is running at full speed without Error Detection And Correction (EDAC) of the RAM. At the moment it is much easier for them to perhaps reboot the system from time to time instead of changing the speed and software.

ALON/ALAT has been measured as 263/0 that is close to the final destination 270/0. In parallel spin has been increased to 9.9 rpm. If everything goes well, the first 400-N-maneuver could already take place on Monday, 11DEC00. Until then it is recommended to use the excellent matching Keplerian elements provided by Ken Ernandes, N2WWD. NASA/NORAD-elements are still a bit mixed up between the different objects. After the orbital maneuver with its new apogee of about 50 000 km the elements will of course be outdated. But new elements will come soon after ranging-procedures. (AMSAT-DL WWW Site)

10DEC00: RUDAK WWW Page Available

I am pleased to announce the availability of an updated set of web pages with information about the RUDAK digital communications system aboard AO-40. A link has been added to the www.amsat.org home page, or you can access the RUDAK information directly at: <http://www.amsat.org/amsat/sats/ao40/rudak/index.html>

We intend to update this frequently with information about our progress turning on and testing the RUDAK subsystem. [per Bdale Garbee, KB0G (ex N3EUA) via amsat-bb]

10DEC00: AO-40 Telemetry Archive

The AO-40 Telemetry Archive at <ftp://ftp.amsat.org/amsat/telemetry/ao40/> has now been updated for all orbits from 0 to 47, and now contains all the block types (not just the A blocks as before). This will now be updated on a regular basis as new data is collected, sorted, and merged.

Paul Williamson, KB5MU, has set up a special email

account ao40-archive@amsat.org for the collection of telemetry from AO-40. Please send all submissions to this email address. I request that all of you who are sending telemetry directly to me at paul.willmott@omsl.bm, please send any future captures to the archive address above.

Many thanks to everyone who has contributed telemetry to the archive, as you will see from the ftp site we have assembled an impressive collection. Please continue to collect and forward as much telemetry as you can. And if you have not forwarded your captures yet, please do so before you delete it. Anything for any orbit is welcome!

Please only send telemetry captured using the P3T program. We have to make sure that only CRCC OK blocks are archived. (per Paul Willmott, VP9MU via amsat-bb)

13DEC00: AO-40 Status Report

Nearly four weeks have now passed since the launch, and there are some good things and some bad things to report.

As you all know, immediately after separation, we could not receive the 70 cm transmitter. Consequently we programmed IHU-2 to act as repeater and used the 2m middle beacon instead as our main downlink. In addition the two S-band transmitters have been operated occasionally, but the geometry within the orbit must be right to have the antennas point into the general direction of earth. This limits the use we can make of S-band.

The main activity so far for the command stations was to learn to fly the s/c and to prepare it for the first burn with the 400 N motor. This required a reorientation - the s/c must point opposite to the perigee orbital speed vector - and a spin-up to about 9 rpm. In view of this ongoing work, it was decided to postpone the analysis of the problem with the

70cm Tx to a time after the first burn.

The reorientation of the spacecraft turned out to be more time-consuming than initially assumed. We had two problems to solve:

1. As we get to our firing attitude, the geometry is very poor for producing directional changes of the spin-vector. The magnetic field of the earth is nearly perpendicular to the spin axis meaning that we can change rpm easily, but not direction. It turned out that rounding errors in the software of the IHU were of the same order of magnitude as the desired spin-change. Thus reliable control was not possible. But careful tweaking of the parameters used in the IHU finally enabled us to solve this problem.

2. The geometry is also poor in terms of attitude determination by our sensors with earth and sun viewed almost from the same direction. In fact for a certain time the earth sensor was blinded by the sun and delivered no useful data at all. But here the YACE camera in conjunction with the IHU-2 came in very handy. By taking pictures of the earth at strategic times we could use the YACE as another earth-sensor looking to the top of the s/c. It gave us badly needed additional data.

The IHU-2 played a vital role in processing and storing these pictures. Unfortunately the IHU-2 turned out not to be so reliable as the IHU-1; every one or two days it crashes. This results in the beacon transmitting only a weak carrier, but no modulation, until the IHU-2 is manually reset from the ground. So far this posed no real problem, but it is a nuisance. Also we have now some data on how the memory is corrupted by radiation.

Eventually we hope to install additional software in the IHU-2 that allows us to avoid or at least automatically recover from these crashes. But this has to wait until things get a bit quieter. Until this time we will have to live with the IHU-2 crashes,



Where Were You When Phase 3D Was Launched? AMSAT-France Members celebrated the launch of Phase 3D/AO-40 at CNES near Paris. From left to right are: AMSAT-F Webmaster Fabrice Way, F4RTP; Former AMSAT-F Secretary Christophe Mercier; AMSAT-F Secretary Jean-Louis Rault, F6AGR; an unidentified supporter, and SATEDU Project Manager Ghislain Ruy, F1HDD.

which seem to be caused by hard radiation and typically occurs, when the s/c comes out of perigee and enters the radiation belts again.

Around Sunday, 10DEC00, we had finally reached the proper orientation and spin for the first 400 N motor burn to take us to 50000 km apogee altitude. After reviewing the various constraints it was decided to execute this burn on Monday, 11DEC00 in the perigee of orbit 50/51. The necessary program was uploaded - this is an automatic sequence since the s/c is at this time at the equator with only 600 km altitude. Thus no command stations can be in contact with the satellite at the time of the burn.

So perigee 50/51 came and went - but the burn did not take place. The stored telemetry was analyzed and it was found that the sequencer went through all the necessary steps, but no helium pressure was built up and consequently the burn did not take place. (It takes helium pressure to open the fuel-valves.)

On Monday, 11DEC00 the situation was investigated and it was found that the pressurization command was not resulting in any action. Initially the investigation concentrated on a software discrepancy, which existed between the software to test the system in Kourou and the one used in flight. But it was found that this probably was not the cause - the valve(s) simply refused to open. We had such a problem before during the test phase of the s/c, and one of the helium valves was repaired as a consequence. All the indications are that we ran again into this type of problem - which may be caused by the age of the components we are using. We then executed multiple open and close commands, which eventually got the helium flowing. But it was also noted that the helium flow was almost an order of magnitude less than required. Still we build up pressure in the tank to nominal and then programmed the s/c to perform the burn on Monday evening.

This time the burn started properly, but there were some anomalies in the telemetry indicating that the burn did not stop at the programmed time but lasted about 3 minutes longer. Thus we achieve an orbit with about 60,000 km apogee altitude. For our ultimate plans this is no problem, we would have used the electric propulsion anyway to further increase the apogee. James Miller had written a data collection program for IHU-2, thus we have a very detailed account of all the events of this burn. A detailed analysis is underway, but we have already some first indications of the nature of the problem and also possible ways to cure it or at least to cope with it, provided that the motor was not damaged by this event.

During the next days we will investigate this matter in detail. If we have a real problem with the 400 N propulsion system, we may need to change our strategy for achieving a useful final orbit. But it may also mean only that we have to observe a number of boundary conditions during the following burns and that the situation may have no impact on the mission goals.

For the next days no attitude changes are planned, thus we will be able to start to investigate the problem with the 70cm TX. During these tests we will find out if we can operationally plan on using the 70cm TX or not. So we are living exciting times.

Finally we would like to express our compliments and our appreciation to the command stations for the superb job they are doing. Each day they are facing new difficulties requiring a very large amount of time and dedication. They are doing a SUPER job. **(via Karl Meinzer, DJ4ZC, AMSAT-DL President and Robin Highton, VE3FRH, AMSAT-NA President)**

13DEC00: AO-40 Keplerian Elements

I received a phone call from NORAD/Space Command yesterday regarding the AO-40's post-burn orbit. Since AO-40 did not achieve the planned orbit from thruster firing #1, I had provided them with estimated set #8 prior to their telephone call. During the conversation, I also reiterated the issue of cross tagging between AO-40 (#26609) and the STRV satellite (#26610). Space Command is currently searching for AO-40 using our elements. They originally intended to create a temporary object with the set #8 Keplerian elements for sensor tracking purposes. They later decided to enter set #8 into their system and task their sensors accordingly. Thus, set #8 appears as set #12 (see below) in NORAD's catalog:

AO-40

```
1 26609U 00072B 00346.67280000 -.00000197
00000-0 00000+0 0 132
```

```
2 26609 6.4207 239.2459 8088586 192.0906
0.4805 1.25602300 510
```

I am quite pleased at the extraordinary level of attention and support that NORAD/Space Command is providing for AO-40. In fact, they appreciate the information and support that we provide them since it makes their satellite catalog maintenance job (i.e., computing orbits for 8500+ man-made objects) a bit easier. AMSAT has established lines of communication with Space Command in recent years, due in part to the credibility we established in exchanging orbital data pertinent to the amateur spacecraft. But AMSAT members should bear in mind that AO-40 (and other amateur spacecraft) are a *very low* priority to them since OSCARs pose no military threat to the security of the North American continent.

On a related topic, I totally sympathize with AMSAT members wanting the latest information on AO-40. (I would be rather disappointed if the interest level were low.) For my part, however, I try to find a balance between providing estimates of AO-40 Keplerian data to the members while not over-doing it to the point of confusion. This requires judgment in which I will, no doubt, err on one side or the other. For that I appreciate the patience that everybody has had thus far. **(per Ken Ernandes, N2WWD via amsat-bb)**

17DEC00: AMSAT-BB Clarifications

The BCR does not need the IHU to regulate or control charging. The IHU is only used for optimizing the battery set-point and solar array offset voltage to get *maximum* efficiency.

<a portion of the text deleted for brevity>

A timeout was expected on Saturday. There were no observations and command stations tried to re-establish communication by sending blind

commands.

Assuming that no commands have been accepted by the IHU-1 since contact was lost on Wednesday, a COMMAND-ASSIST watchdog will be invoked at orbit=65, MA=0 which is 2000 Dec 21 [Thu] 23:55 UTC.

The COMMAND-ASSIST routine will cycle through various RX, TX, Hi-gain and Low-Gain antennas.

If commands were received by the spacecraft (although we have not seen any successful commands so far), than the COMMAND-ASSIST watchdog will be reset for another 10 orbits. In this case we may see this function happen not before 25DEC00.

Please note that this is a *software* watchdog. There is no hardware watchdog. If the IHU has crashed, than a RESET command can be issued from ground. This would be the last resort. It is a very fail-safe system, which has been used before on AO-10 and AO-13. However, it was decided to check and analyze all other possibilities before issuing such a drastic command. There is no need to hurry and we don't want to miss any option.

We also got reports that these signals might be *fake* PSK signals sent by someone through AO-10, which was visible at the same time.

The command team is still very interested in any signal report, but please make sure that these signals come from the right direction, etc. **(per Peter Guelzow, DB2OS via amsat-bb)**

18DEC00 - NORAD Has Found AO-40 to be in One Piece

The radar cross section was as expected with no other pieces found nearby. This should end speculation of an explosion as NORAD found only one object with a radar cross section that was consistent with a satellite the size of AO-40. The command station team is continuing recovery operations. Ken Ernandes, N2WWD has provided the following preliminary Keplerian elements based on a single radar pass. More accurate orbital elements should follow from NORAD in the near future following a second radar pass that should provide time and geometric distribution of the tracking data. **(via ANS)**

AO-40

```
1 26609U 00072B 00352.42798611 .00000000
00000-0 00000-0 0 115
```

```
2 26609 6.3033 237.3129 8126708 194.7923
102.4478 1.27093349 581
```

18DEC00: Command Station News

I was going to post a detailed reply message, but the AO-40 situation has perfectly been summarized by Peter Guelzow, DB2OS (above). We won't know for sure if the IHU-1 has crashed until 21DEC00 or, perhaps, 25DEC00. Issuing a blind reset command before that time has the possibility of making things worse. Meanwhile, the solar angle is good, the BCR's are self-functional and the power budget is positive. There is every reason to move slowly. If the COMMAND-ASSIST software does not cycle TX's and RX's on 21DEC00 or 25DEC00, then we will move forward with other options.

I would also like to say thanks so much to those of you who have sent messages of support. They are very much appreciated by all of us. To those of you who have suggested that Phase 3D was in some way "rushed" to launch, I can only say that this couldn't be further from the truth. Remember, launch of this satellite was delayed for several years... it sat in a shipping container in Kourou, ready to go for months. There is no question that it was fully ready for launch. When the checkout team left Kourou we were completely satisfied that Phase 3D was a fully functional spacecraft, ready for flight. Let me say that again, this satellite had zero known defects at the time of launch, period. Several of the *defects* that have been mentioned, such as *rounding errors* in the magnetorquing software are completely expected parts of the checkout process. This is not a *defect*, it's a calibration process. We cannot calibrate the satellite properly until it is in space.

The command team remains very hopeful that we can recover Phase 3D, but remember, this really is rocket science. There are no absolute guarantees. If we had been on the Ariane 501 as initially slated, we would have been vaporware from the time of launch.

Regardless of the outcome with AO-40, AMSAT needs, and I believe deserves, your continued support, now more than ever. Thanks." (per Stacey Mills, W4SM via amsat-bb)

22DEC00: Command-Assist Routine Failure

The COMMAND-ASSIST emergency routine didn't start on 21DEC00. Command stations still want to avoid sending a possible hard-reset to the IHU as this could lead to a loss of all data captured during the 13DEC00 event. NORAD has released again a new, more detailed dataset for AO-40. Bob McGwier checked the following Keplerian elements with reported AOS/LOS-times from 11-13DEC00 and found only delays that were ranging in seconds. So there is no evidence for any other orbit-changing event except the planned motor-burn on 11DEC00. Reports about GB signals of the 70-cm-exciter close to perigee have to be further verified. (via AMSAT-DL WWW Site)

AO-40

1 26609U 00072B 00354.78150683 -.00000292
00000-0 00000 0 0 165

2 26609 6.2479 237.0656 8128421 195.4843
97.8405 1.26866570 613

23DEC00: IPS Programming Thoughts

I was fortunate enough to get a copy of the IPS programming manual. With the aid of the manual I went back over the last few minutes of AO-40 telemetry. The interpretation here is very limited since I don't have access to the source code for AO-40. (Nor am I any more than a novice with the IPS language.) Here is what I found:

All of this occurred Wed, 13DEC00.

11:16:51 UTC I received a telemetry 0 block containing "MANY_ARMS ... UNZUL. NAME !" MANY_ARMS is an IPS program (subroutine) that cycles power for something. UNZUL. NAME ! is

an IPS error message meaning DUPLICATE NAME !

11:17:18 UTC an A block of standard telemetry.
11:17:32 UTC an A block of standard telemetry
11:21:03 UTC a 0 block containing PP2
<DE><A2>p ... this repeats many times.

11:21:15 UTC same as above

11:21:28 UTC same as above

11:21:40 UTC same as above

11:21:53 UTC same as above

11:22:06 UTC same as above

11:22:18 UTC same as above

11:22:31 UTC same as above Note: this is the last block of data from the satellite (that I received)

The numbers in < > brackets above are HEX numbers. I have not included all the contents of the telemetry blocks for brevity. You can get them from the AMSAT archives if you are interested.

Did some bad code get uploaded? As a programmer I have to admit that I have seen some of my programs do similar things when I goofed. Especially on the old 8 bit machines with primitive operating systems, I've seen the console start scrolling more than once. If that's what happened to AO-40 then I have great hope that a RESET will do the trick.

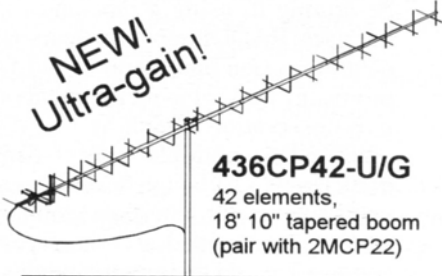
Good luck command team! Thanks for all your hard work! (per Rich Burgan, WC8J via amsat-bb)

I believe that power was being cycled on the He valves. They told us they were working on the propulsion system problem. I am producing a table of the values that you produced from before for the last few minutes of the telemetry to check for anomalous behavior in the pressure. Do you happen to have audio from that segment? If not, does anyone else?

What I think is clear from the telemetry around the burn is that something is not right with the regulator. The low-pressure side of the regulator should be nearly a constant to prevent adiabatic expansion cooling. This adiabatic cooling could explain the longer than normal burn since the pressure was falling on the low-pressure side. We definitely have a problem if I am interpreting the telemetry correctly. We are going to have to do smaller, shorter burns if the prop flow pressure regulator is not working right. I need to do a calculation or two to make a SWAG at the temperature drop in the regulator.

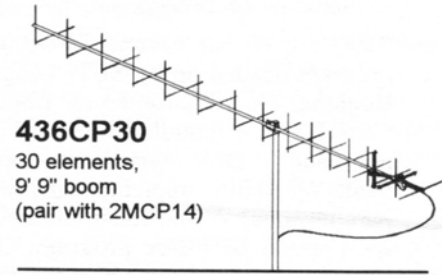
I am guessing but this seems to be the right way of thinking. Phil Karn and Franklin Antonio pointed me right to it and asked where the expansion was taking place. I looked at the telemetry and saw the low-pressure side falling constantly. It was stupid of me to miss it. The temperature didn't drop dramatically in the Prop and Oxidizer tanks but the fall of 15.2 Bar to 7.7 Bar on the low pressure side of the regulator says it *ain't right* since it is supposed

M² YOUR SATELLITE ANTENNA SOURCE

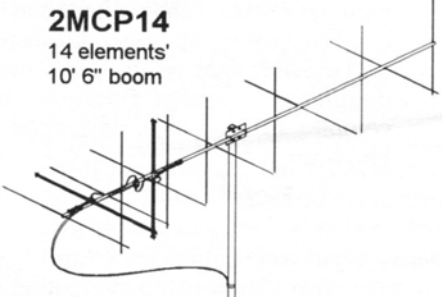


**NEW!
Ultra-gain!**

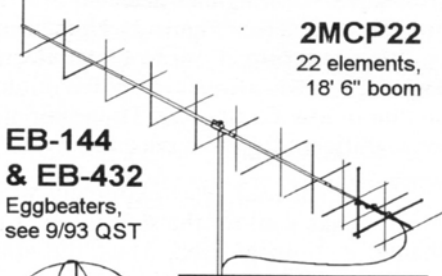
436CP42-U/G
42 elements,
18' 10" tapered boom
(pair with 2MCP22)



436CP30
30 elements,
9' 9" boom
(pair with 2MCP14)



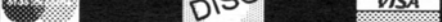
2MCP14
14 elements'
10' 6" boom



2MCP22
22 elements,
18' 6" boom



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to be regulating.

I think I am interpreting these numbers all correctly. If anyone official wants to point me in a different direction I will be happy to take the prodding to stop the idle speculation. (per Bob McGwier, N4HY via amsat-bb)

23DEC00: We Wish You a Merry Christmas

Even during the Christmas holidays AO-40-command stations are active. Peter Guelzow, DB2OS, told that after another attempt of commanding AO-40 without reaction, it must be assumed the IHU-1 has crashed. Preparations of a special RESET-software are underway to switch transmitter and IF-matrix immediately to 2 M MB without uploading the whole operational software

before. The RESET can be tried on one of the days following a successful testing of the software on ground. (via AMSAT-DL WWW site)

24DEC00: AO-40's Stable Orbit

One other question to be considered is whether the current orbit is stable? I know next to nothing about orbital mechanics. But AO-13 died a fiery death because of an orbital instability. We wouldn't want the same thing to happen to Phase 3D. But then again, it might be fine. (per Jon Ogden, NA9D via amsat-bb)

I'll take a shot at this one. The orbit is incredibly stable. It's not the eccentricity per se that creates instability. It's the combination of eccentricity and high inclination, along with RAAN and ArgP that has the potential for instability due to solar/lunar

forces. The current low inclination orbit is highly stable. I've integrated the orbital elements, accounting for drag, and the pull of the sun and moon for decades and the orbit is quite stable. Perigee height varies by several hundred km and there is some very minor drag loss when the perigee is at its lowest point, but there is also gravitational "pumping" of energy into the orbit. In fact, after 40 years, mean motion is 1.266, lower (i.e. a higher energy orbit) than it is today. For a graph of the orbital elements over the next approximately 10 years, 20 years and 40 years download:

www.cstone.net/~w4sm2/software2/AO40-10.gif

www.cstone.net/~w4sm2/software2/AO40-20.gif

www.cstone.net/~w4sm2/software2/AO40-40.gif

Note: These graphs, particularly the 40-year graph are very busy and difficult to read. However, note that mean motion barely changes and height at perigee shows a cyclic variation from a low of about 270 km to a high of about 700 km. If you look carefully, you will also see the cyclic effects of the sun and the moon on the orbital elements. (per Stacey Mills, W4SM via amsat-bb)

24DEC00: AO-40 Reset Commands Initiated

Dear All, Command stations have already started sending RESET commands to the spacecraft and to upload a small program to re-configure the TX and MATRIX for Middle Beacon on 2m. So far there is no success. Command stations will continue to reset and upload using different command receivers. Even if we do not have immediate success, there are still a couple of possibilities to try. AO-10 is close to the same spot in the sky at the moment as AO-40. Unfortunately some moron has figured out how to send 400 bps PSK with the proper downlink sync vector and is blasting away through AO-10 at the approximate AO-40 downlink frequency. He's transmitting AO-40 decoded telemetry frames from another program. Fortunately, this idiot is too stupid to put the telemetry blocks in the proper format and what appears is ASCII text in a decoded format, rather than true AO-40 telemetry blocks.

So, be warned if you see something which sounds like AO-40 on 2m, it may not be AO-40; this all isn't funny, but let's think positive. 73, Peter (per Peter Guelzow, DB2OS via amsat-bb)

25DEC00: AO-40 Heard!

We just got information from New Zealand and Australia, that AO-40 is back on Air! At 21:45 UTC on 25DEC00, Ian Ashley, ZL1AOX sent a RESET command through L-band and an initialization block to switch the S2 S-Band transmitter On.

Just after the first attempt the S2 beacon came on 2401.305 MHz, Signal was about S5 to 6 that was comparable to when S2 was heard last during testing.

At 00:30 UTC, 26DEC00 signal strength has dropped to below S1 over a period of 30 minutes.

The beacon was confirmed by several other stations in Australia, including Graham Ratcliff, VK5AGR.

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P50VDG	50-54	<0.5	24	+12	GaAsFET	\$79.95
P144VD	144-148	<1.5	15	0	DGFET	\$29.95
P144VDA	144-148	<1.0	15	0	DGFET	\$37.95
P144VDG	144-148	<0.5	24	+12	GaAsFET	\$79.95
P220VD	220-225	<1.8	15	0	DGFET	\$29.95
P220VDA	220-225	<1.2	15	0	DGFET	\$37.95
P220VDG	220-225	<0.5	20	+12	GaAsFET	\$79.95
P432VD	420-450	<1.8	15	-20	Bipolar	\$32.95
P432VDA	420-450	<1.1	17	-20	Bipolar	\$49.95
P432VDG	420-450	<0.5	16	+12	GaAsFET	\$79.95

Inline (rf switched)						
SP28VD	28-30	<1.2	15	0	DGFET	\$59.95
SP50VD	50-54	<1.4	15	0	DGFET	\$59.95
SP50VDG	50-54	<0.55	24	+12	GaAsFET	\$109.95
SP144VD	144-148	<1.6	15	0	DGFET	\$59.95
SP144VDA	144-148	<1.1	15	0	DGFET	\$67.95
SP144VDG	144-148	<0.55	24	+12	GaAsFET	\$109.95
SP220VD	220-225	<1.9	15	0	DGFET	\$59.95
SP220VDA	220-225	<1.3	15	0	DGFET	\$67.95
SP220VDG	220-225	<0.55	20	+12	GaAsFET	\$109.95
SP432VD	420-450	<1.9	15	-20	Bipolar	\$62.95
SP432VDA	420-450	<1.2	17	-20	Bipolar	\$79.95
SP432VDG	420-450	<0.55	16	+12	GaAsFET	\$109.95

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Assuming this is true, we have a long way to go, but it's sure a step in the right direction! The next thing is trying to upload IPS.

All previous attempts in the last 2 days to turn V-band On were unsuccessful, so we changed the strategy to try on S-Band.

Merry Christmas and Congratulations to Ian!!
73, Peter Guelzow, DB2OS (via amsat-bb)

25DEC00: AO-40 S2 Beacon is Steady

Just a quick note, that the S2 beacon produced a steady signal and from the Doppler wobbling it is also clear that it is in fact coming from AO-40. Ian Ashley, ZL1AOX reported that he was able to copy and observe (with Spectrogram) the S2 beacon. His LOS time was 03:45:15 UTC at 26DEC00.

Predicted LOS from NORAD set#12 Keplerian elements gave 5 seconds later. All visible trace of the S2 beacon disappeared within 45 seconds of predicted LOS. Approximate distance was 61,470 km.

It seems that the output power of the S2 beacon is holding well.

In the past few hours, James Miller, G3RUH and Stacey Mills, W4SM have re-coded and recompiled IPS so that it does not change our current Tx/Rx settings. As before, this is a 15 block binary upload. James has stripped the ground software that we ran in Orlando and Kourou down to two blocks, and Stacey updated the full flight software to take recent changes into account.

Tomorrow, 26DEC00 at about 16:05 UTC, ZL1AOX will acquire AO-40 shortly after perigee with a reasonably good squint angle. He will then start reloading the IPS software.

Until then the beacon will not carry any telemetry, just a carrier. Once the bootloader for IPS is up, you will see "X" blocks in the telemetry until IPS is completely loaded...

What a wonderful day! (per Peter Guelzow, DB2OS via amsat-bb)

26DEC00: AO-40 Transmitting on S-Band

ANS is pleased to confirm that AO-40 is transmitting on 2401.305 MHz. Prior to this confirmation the satellite had not transmitted any signals since 13DEC00, which was shortly after the first burn of the 400-N motor. Peter Guelzow, DB2OS, provided ANS with the following information:

On 25DEC00 at 21:45 UTC command station ZL1AOX transmitted a L-band reset command which included an initialization block to switch 'on' one of the two S-band transmitters onboard AO-40. Just after the first attempt, AO-40's S-2 beacon was received by Ian, ZL1AOX, on 2401.305 MHz. The signal strength was S-5 to S-6, which compares to S-2 when the beacon was last heard last during testing in early December.

AO-40's S-band transmitter produced a steady

signal at ZL1AOX and from the Doppler wobbling it was also clear that it was in fact coming from AO-40. ZL1AOX reported that he was able to copy and observe the S-2 beacon until LOS at 03:45:15 UTC. Predicted LOS from NORAD's orbital set #12 indicated a LOS within 5 seconds of that time. At the time of reception, AO-40's approximate distance from ZL1AOX was 61,470 kilometers.

Later today (26DEC00), Ian Ashley, ZL1AOX will re-acquire AO-40 shortly after perigee with a reasonably good squint angle. He will then start reloading AO-40's IPS software. Until that task is completed, AO-40's beacon will not carry any telemetry, just carrier.

26DEC00: AO-40 Telemetry Copied in Austria

The AO-40 telemetry beacon could be continuously heard on 2401.322 MHz +/- Doppler in JN88DF in Vienna, Austria for more than six hours. Distance varied between 57000 and 7000km, but the all the time the squint-angle was around 135+/-20°, just the antenna and satellite backside only. Signal was for most of the time buried in the noise, but during the last hour before LOS increased substantially:

15:00 UTC: 15000km, 8 dB above noise, 2-3 dB spin modulation

15:35 UTC: 7000km, 12 dB above noise, 4-5 dB spin modulation

15:36:40 UTC: LOS (consistent with latest NORAD elements)

Equipment: 1.2m dish, helical feed and preamp via an IC-970 (per Viktor Kudielka, OE1VKW via amsat-bb)

26DEC00: More Good News

Ian Ashley, ZL1AOX has successfully uploaded IPS and we have now first telemetry. We are currently investigating the telemetry to determine the status and health of the spacecraft. The spacecraft will only transmit on S-Band and we will not switch TX configuration to V-Band until we have a better knowledge of the s/c status. (per Peter Guelzow, DB2OS via amsat-bb)

26DEC00: AO-40 is S-7 in Alabama

ASCII text indicates "Hi this is AO-40, AO-40 Recovery Program v1.1" Station is AO-13 class S-Band. Any controllers interested in telemetry please E-Mail me privately at ddej1@home.com. 73 and thanks to the controllers, Don De Jarnette, KC4YRT (via amsat-bb)

26DEC00: Additional AO-40 S-Band News

AMSAT-DL President (and P3D Project leader) Dr. Karl Meinzer, DJ4ZC, provided ANS with additional information regarding AO-40's recent S-band transmissions on 2401.305 MHz:

Ian Ashley, ZL1AOX, has succeeded in loading IPS software and a minimal operational package into AO-40. As a consequence, AO-40 is now sending telemetry (A blocks) that will enable an analysis of the status of the spacecraft.

A first (quick) look has revealed that some temperature sensors and possibly some current sensors have been lost by whatever incident caused the telemetry transmissions to stop. However, the power situation, in particular the battery voltages, look nominal.

We will now start a detailed analysis of the situation; the command stations will continue to follow a conservative philosophy with the primary goal of not causing any additional damage along with retaining as much evidence as possible for the analysis of the incident.

Furthermore, command stations will now try to uplink the entire operational software package, which in particular should establish positive control over the power generation system. From there on, the communications capabilities of the spacecraft will be explored. The 2-meter transmitter is considered off limits for the time being (in case that it may have been damaged and thus might have the potential to cause the IHU to crash). The risk is too large before the Warte-Orbits and Command-Assist programs have been updated to reflect the actual capabilities of the satellite available after the incident.

In summary, we can state that the command stations have now regained control over AO-40. During the next few days we hope to learn to what extent the satellite was damaged and to what extent this will impact mission targets.

When we have further analysis, I will report again. 73's, Karl Meinzer, DJ4ZC (via ANS)

27DEC00: AO-40 Recovery Continues

Recovery of AO-40 continues and some housekeeping tasks were performed by the command stations to improve and stabilize the situation. In addition, new software routines were successfully loaded to restore the BCR-Service and other housekeeping functions. The BCR's (Battery Charge Regulator) also works fine and we have a positive power budget with happy batteries. A quick look at the LIU instrumentation showed that the Helium high pressure was essentially where we left it after the first 400N motor burn (173 bar). It was found that a few temperature sensors have failed and also some of the current sensors are showing wrong values. The sun sensors seem to work fine and showed a solar angle of 31 degs, close to predicted. The spin rate needs some recalibrating. The real spin rate appears to be in the range of 16 RPM (as measured by the Doppler wobbling on the S-Band beacon). This is a substantial increase compared to the 9 RPM before the incident. This could be due to a leak, although the difference in mass ($m1/m2 = w2/w1$) is more than the available liquid fuel, thus the way it left the spacecraft increased the spin too. Clearly, we need more time to analyze and understand what has happened here. Basically it seems that the spacecraft is now fully under control again. In the next days some more software will be loaded and the various uplinks will be verified before we will try to turn the 2m TX on again. However, there are no indications that the TX has failed, but we will make sure not to lose communication again. So for the next days the spacecraft will continue to be transmitting on S-Band only. 73, Peter Guelzow, DB2OS for the whole Command Team (via amsat-bb)

28DEC00: New Flight Software Loaded

We are pleased to report that the AO-40 Flight Software is now completely re-loaded, excepting the D-block and WOD routines which can be done later.

James Miller, G3RUH found that commanding on L-band was very easy. Even at a very bad pointing angle of ~50 deg he could upload a non-FEC block on 4 watts at the TX (~250w e.i.r.p.). Thus the L-Band uplink seems to work nominally and excellent. 73, Peter Guelzow, DB2OS for the Command Team (via amsat-bb)

Here are two snapshots of the headers of telemetry A-blocks with the announcements of flight software:

A HI, THIS IS AMSAT AO-40 2000-12-28
07:29:33 #0035

AO-40 Recovery program v1.2

A HI, THIS IS AMSAT OSCAR-40 2000-12-28
07:34:46 #0037

AO-40 now has fully reloaded flight software! Stay tuned!! |

(per Viktor Kudielka, OE1VKW via amsat-bb)

28DEC00: Telemetry Reports

Since control was regained of AO-40 it has been transmitting on the S2 MB beacon only. The published frequency of 2401.350 is not correct as the actual frequency of this beacon has yet to be calibrated. However, from various reception reports it would appear that a frequency between 2401.322 and 2401.328 MHz seems likely (without Doppler). The 2401.305 MHz value published in ANS was the command station's frequency on the dial (i.e. with Doppler for that station at that time).

From the three orbits that we have telemetry for, it is clear that the only chance of receiving AO-40 S2 MB is from MA16 to MA32. That may mean getting up late at night, or very early morning. Reception outside of this part of the orbit will be very unlikely given the antenna pointing angles.

From the archive here are the good capture results:

Orbit 71 - 187 CRCC OK A Blocks, 2000-12-26
17:00:54 - 17:54:20 UTC MA 20 to 32

Orbit 72 - 128 CRCC OK A Blocks, 2000-12-27
11:34:59 - 12:52:25 UTC MA 16 to 19, MA 24 to 3

Orbit 73 - 130 CRCC OK A Blocks, 2000-12-28
06:33:01 - 07:34:46 UTC MA 16 to 24

This was the best that we could get for the complete orbits! Same results for three orbits, nothing different today! Also remember that this is a 19-hour orbit, with an apogee at 60000km, the bird doesn't spend much time close to home. (per Paul Willmott, VP9MU via amsat-bb)

29DEC00: AO-40 Telemetry Server

I am setting up an AO-40 telemetry meta-server at the NASA Goddard Spaceflight Center Amateur Radio Club. The purpose of the meta-server is to allow folks who are receiving the AO-40 telemetry beacon with either P3T or IZ8BLY's sound card demodulator to flow telemetry to a central point. Anyone on the net will be able to connect to it with P3T to receive telemetry. This will eliminate the need to know who is providing the data. Everyone will always connect to the same address. Also I will be able to provide simultaneous connections to hundreds (or even thousands!) of users. I will let everyone know how to send telemetry to and receive telemetry from the server as soon as I get it set up. (per Ron Parise, WA4SIR via amsat-bb)

29DEC00: AO-40 From Vermont

I started looking for the S2 Beacon today in Vermont at 1830 UTC. I acquired it at 1844 UTC. AO-40 was 14,000 km away at the time with a squint angle of 160 degrees! (based on hi-gain calculation in NOVA for Windows). This was MA 245. I was able to track it with Spectrogram right to my LOS that was at MA 251. At this time it had a 135 degree squint and was 8600 km away.

Unfortunately I was unable to decode any telemetry. The signals were just too weak. I now have what I consider a good benchmark for the performance my BBQ dish and Drake converter. Next is to add the 2401 MHz mast mount preamp and try again. (per Mike Seguin, N1JEZ via amsat-bb)

01JAN01: AO-40 on New Years Day

This first report to the membership in 2001 on AO-40 is somewhat brief but covers the situation as I see it on January 1 2001, and hopefully will fill the gap of missing information over the past few days.

Firstly let me say that the command team has not stopped its investigations during the holidays, now that communications have been made with AO-40 the team has started to get good telemetry data from the bird on "S-band" (2.4 GHz).

However copy is only available during the earlier parts of each pass (typically MA 14-39) due to the offset of the antenna with respect to earth. This restricts the amount communications that can take place each pass. The data that has been recovered is being analyzed carefully to try and determine a number of things such as:

What actually happened?

Why did it happen?

What telemetry functions are known to be correct?

What telemetry data is suspect?

Why is some data suspect?

What is the actual attitude of the spacecraft with respect to earth?

Has the attitude changed?

What is the spin velocity? Has it changed?

What is the state of the batteries?

Are the battery chargers and regulators working?

What happened to the IHU 1 & 2 and why?

Are all the antennas operational?

What can we do next to improve the communications?

What risks are involved?

When questions such as these, and many others, are answered it may be possible to determine the working capability of the spacecraft and if appropriate, to start to try operation on other bands. Much analysis work remains to be completed, and I know that the command team will try to keep us all informed when they can answer the questions.

Over the next week or two some critical decisions will be made, they will be based on the results of the analysis, and a lot of discussion among the command team.

Meanwhile lets hope that the first week or two of the New Year will bring the same joy and relief to us all as the initial news of 25DEC00.

Wishing you all a very Happy New Year and 73, Robin Haighton, VE3FRH, President AMSAT-NA (via amsat-bb) ■

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Minutes of the AMSAT Board of Director's Meeting

Held October 29 and 30, 2000 in Portland, Maine

The meeting was convened at 1:05 PM EST on Sunday, October 29, 2000 at the Holiday Inn Portland West, Portland Maine.

Members of the Board of Directors (BoD) in attendance were:

Barry Baines WD4ASW
Keith Baker KB1SF
Tom Clark W3IWI
Dick Daniels W4PUJ
Robin Haighton VE3FRH
Andy MacAllister W5ACM
Bill Tynan W3XO Chairman

Others participating at various times included:

Frank Bauer KA3HDO - VP Manned Space Programs
(by telephone)
Larry Brown W7LB - Area Coordinator
Bill Burden W1BRE - VP Strategic Planning
Art Feller W4ART - Treasurer
Bruce Paige KK5DO - Alternate BoD Member & Area Coordinator
Keith Pugh W5IU - VP Operations
Martha Saragovitz - Corporate Secretary/Office Manager
Ray Soifer W2RS - VP International
Russ Tillman K5NRK - VP Publications and Journal Editor
Paul Williamson KB5MU - VP Electronic Publishing

The following Board members also hold the offices indicated:

Keith Baker KB1SF - President
Robin Haighton VE3FRH - Executive Vice President
Barry Baines WD4ASW - VP Field Operations
Andy MacAllister W5ACM - VP User Services

I. Election and Appointment of Officers

Newly elected First Alternate Board (BoD) member Paige was recognized. Tynan noted that Bruce is an excellent representative of the satellite user community. It was announced that Mike Gilchrist had been elected as the Second Alternate. The first order of business was the election of officers. It was announced with regret that Keith Baker who has served as President for the past two years is not standing for reelection. Noting that he had served for 4 years as Executive VP and two years as President, Baker explained his belief that those serving as senior officers in volunteer organizations should, in due time, return to the ranks to make way for new faces. Baker then nominated Robin Haighton presently Executive VP to be his successor noting that he had been working closely with him and that Robin has been doing an increasing amount of the day-to-day work. Clark seconded the motion. As there were no further nominations, Haighton was elected President by unanimous vote.

Nominations for Executive VP were then accepted. Haighton nominated Ray Soifer. The nomination was seconded by Clark. There being no other nominations, Soifer was elected by unanimous vote.

Haighton noted the assistance rendered by past presidents to the newly elected President, and suggested that they should be recognized for this service with a title such as *Immediate Past President*, and moved that such a title be established. MacAllister seconded this motion. After discussion, the motion passed with 5 voting in favor. Baker accepted with thanks noting that the title might be appropriate to use when he is called upon to represent AMSAT before other organizations.

The other offices to be filled were next considered, with Clark nominating Saragovitz to continue to serve as Corporate Secretary. Baines seconded and Martha was reelected by acclamation. Clark then nominated Feller to continue as Treasurer. This was seconded by Haighton. Art Feller was reelected and thanked for his past work. It was announced that the present VP for Engineering Stan Wood, WA4NFY had agreed to continue in that position, and was nominated by Haighton. Clark seconded. In response to a question by MacAllister, Tynan responded that no other person was known to have offered to serve in this position. Whereupon, Wood was reelected. Keith Pugh agreed to continue to serve VP Operations and was nominated by Clark. Baines provided a second and Pugh was declared elected. Baker nominated Tynan to continue as Chairman of the Board. This was seconded by Haighton and he too was reelected. Other officers are to be appointed by the President with no Board action required.

II. Presentation of the Budget for 2000

Treasurer Feller distributed copies of the proposed Budget, commenting that it represents a joint effort by Baker, Haighton, Saragovitz, in addition to him. He noted that income projections tend to be low and expenditures high, and thus some deficit may result. But, due to the conservative nature of the various forecasts, we should come out quite well at the end of the year.

Discussion followed regarding Travel Expenses in connection with ARISS. Haighton stated that ARRL has indicated a willingness to support one-half of the travel and other Space Station related expenses, up to a maximum of \$25,000. A note to this effect will be added to the budget.

Feller noted that, in accordance with our usual practice, the Budget will be adjusted as necessary as each department head presents his report.

The Treasurer was thanked for his excellent work on the Budget.

III. Strategic Planning Committee Report

Burden reported on the meeting held earlier in the day at which the Committee reported on its progress

to date, and received comments from those attending. He said that these comments form a helpful basis for him and Russ Tillman to assemble a synopsis for a future Journal article concerning the progress made by the Committee. Meanwhile, he emphasized that the lines of communication with the membership remain open.

A discussion followed of past efforts to plan for the future. Baker opined that AMSAT has historically been an *enabling organization* providing the structure for those with ideas to pursue their projects. An example cited was the Microsats. Others, including Tynan have suggested that the time may have come for us to transition to an organization in which the leadership, including the Board, officers and perhaps key technical advisors, might propose objectives and then find people and resources to achieve them. Much discussion followed concerning this potential change in strategy.

Burden then highlighted the differences between long range planning and strategic planning, saying that strategy should answer the question of why the organization exists. He cited the example of the ARRL that concluded that its principal reason for existence is to protect the amateur spectrum.

Baines contended that discussion at the meeting did not clearly present what the Committee thinks about answering the issues raised in Tillman's memo describing the progress of the Strategic Planning Committee. For one thing, he said, it seemed unclear what the Strategy Team's perspective is, having hoped to hear specific recommendations. Burden responded that the group had not yet reached that point, citing the need for an internal consensus first developed through face-to-face meetings. So far, all the group's deliberations have been via e-mail; that has proved to be a less than satisfactory means of exchanging ideas and reaching consensus. Haighton agreed, and urged that face-to-face meetings be held. Burden said that he would like to have one such gathering before the next BoD meeting. Saragovitz pointed out that holding meetings will require an adjustment to the Budget and suggested that a new department be established. Feller agreed and suggested using Department 12 to be called Long Range Planning.

It was suggested that Tillman and Burden meet and recommend an appropriate amount to budget for meetings and teleconference costs for this department.

Baker expressed the opinion that AMSAT should define what it is and what it does. Having done that, future activities and approaches may become obvious. Tynan recommended consulting the Bylaws, which among other things, say that we build satellites for use by the Amateur Radio community.

Burden said that going through the process of preparing a strategic planning report is worth the journey but cautioned that, in the corporate world, such documents are frequently put on the shelf and forgotten. On the other hand, some organizations, including ARRL, do review their strategic plans from time to time and determine if current activities are

in accord with them; or if changes should be made to the plan to meet new conditions.

Burden then noted that, although the outcome of the Phase 3D launch assuredly has a big role to play in AMSAT's future plans, that fact had been largely ignored. He indicated that this oversight has been brought to the attention of the Committee. This brought an extended discussion of how AMSAT should use Phase 3D to promote the organization. Articles in the amateur press and elsewhere were suggested. It was suggested that those most knowledgeable regarding the satellite, the designers and builders, be encouraged to document material that can be used in various publications and other media. Tynan noted that such effort had been the AMSAT approach since its inception, but agreed with a comment from Daniels that we had not always succeeded as well as we might like. Tynan contended that media such as our Web page, ANS, *The AMSAT Journal*, the various nets, especially the Houston AMSAT Net with its nationwide distribution, are all tools we are using and should use to inform the amateur community about the advantages to be gained from Phase 3D. Burden commented that ARRL looks at Phase 3D in a somewhat different way, as a means of showing occupancy of the higher frequency amateur bands in order to protect them.

Haighton suggested, as a way of improving our visibility, the establishment of a strategic goal; the publication of AMSAT's achievements to date, including Phase 3D.

IV. Report of the New Projects Committee

Haighton stated that the objective of the group is to evaluate various proposals for new projects and make recommendations to the Board. Previously, he noted, this function was performed by the Board itself. Membership has been selected to include those with a broad variety of technical and other skills. Current members are Tillman, Burden, Gilchrist, Jansson, Kanawati, Marchant, Mills, Soifer, Shultz and White. Daniels asked if there had been any proposals received by the group so far. Haighton replied that no viable projects had yet been handed to the Committee, however it is ready to receive any. He explained that there are two types of tasks to deal with, those requests by perspective satellite builders asking for suggestions on appropriate payloads, and requests by groups that have their own project and are seeking AMSAT's participation. Haighton then made the suggestion that Soifer assume the leadership of the Committee and present the remainder of the report.

Soifer said that at the IARU Forum held this year at Surrey in the UK, it was stated that prospective satellite builders, especially university groups, need to be informed as to what it is that radio amateurs would like to see them build. Often these groups come up with ideas which only fulfill their specific educational goals, when something that could be useful to the amateur community might fulfill their education requirements just as well. He emphasized, however, that these student-built satellites, even if they are of value to the amateur community, cannot be regarded as a free resource, because they often require technical guidance from AMSAT volunteers. Soifer said that he hoped, that in the coming year, we will be in a position to provide the needed guidance to these kinds of projects. To do this, it may be necessary to add appropriate new members to the Committee.

He then asked about budget provisions for the Committee, noting that the present the existing Department 13, is the most appropriate place to handle this activity. Saragovitz agreed. Feller explained that start-up money is provided under Department 13 and then, if a specific project continues it is then transferred to its own dedicated department. Haighton noted that \$5000 had been budgeted for the New Projects Committee.

Daniels noted that some of the Phase 3D builders have been asking what they might work on next. He recommended that a study group be established to determine what the next AMSAT-NA initiative ought to be. Tynan agreed, noting with pleasure hearing from Bdale Garbee, at the morning meeting, that he was ready to take on new projects.

Daniels recalled that while the study for a Phase IV synchronous satellite was unsuccessful, in that it did not result in a spacecraft, it did provide the basis for some of what we did on Phase 3D. He emphasized, however, that it convinced us that, because of financial and political factors, a geosynchronous satellite was not a feasible project for us. He went on to recommend that a formal effort soon be made to define a new initiative to give those wanting to work on a project something to do. He advised going to those who actually build satellites for suggestions. Tynan noted that some good ideas came up at the general meeting just concluded. These included a wideband spread spectrum transponder for the ISS by Matthew Ettus and ideas by Dick Jansson for a low cost, high altitude satellite (P3E) that can be completed and launched in three years or less. Tynan noted, also, the suggestion made by Peter Guelzow, DB2OS for a satellite that would be left in Geostationary Transfer Orbit (GTO), thus eliminating the need for on-board propulsion.

Daniels cautioned, however, that we no longer have available some of those who have been particularly good at leading technical teams. He specifically cited Jan King. He emphasized that we must keep this in mind in considering any new projects. He also reminded the group that the LEAST project, currently underway, is now using the talents of some of our best designers. Tynan noted that AMSAT's work with the ARISS project is also in that category. Haighton commented that LEAST should be complete sometime in January 2001. Tynan opined that, while it was not necessary to start work immediately on a new project we should be ready to act in accordance with what the New Projects Committee recommends.

Soifer, citing earlier discussions with Feller, asked for the sense of the Board as to whether AMSAT's work with universities should be undertaken only if we feel that the resulting spacecraft is qualified to be licensed in the amateur-satellite service. It was generally agreed that we should, but that we should not be the final authority as to whether a particular satellite should be in the amateur-satellite service, and that we should make it clear that we are not the gatekeepers. It was noted that the IARU document *Information for Prospective Owners and Operators of Satellites Utilizing Frequencies Allocated to the Amateur-Satellite Service* should be cited, and let the group proposing the project make their own decision based on that document. But, it was generally agreed that we should be ready to provide advice and guidance including information on how RF frequencies are managed, especially alternatives to the amateur-satellite service for projects that we don't feel belong in that service.

Feller emphasized that amateur satellites are not licensed to organizations, but to individual Amateur Radio station licensees or trustees of club stations. Thus, one person has the responsibility for the spacecraft's operation. Soifer urged that we be in a position to advise builders about alternatives to licensing in the amateur-satellite service.

Daniels noted that, for satellites that do belong in the amateur-satellite service, we make clear early in the project, the role of the IARU Satellite Frequency Coordinator.

The idea was advanced of sponsoring another education seminar similar to the one we held in 1999, in connection with our 2001 annual meeting. Such a short (two day) seminar could provide a forum for furnishing information on frequency management including alternatives to licensing in the amateur-satellite service. Clark urged that the instruction not be limited to frequency management issues, but also include sessions on various aspects of satellite design and testing. He cited the presentations made by the Dartmouth students at this Symposium as evidence of the kind of enthusiasm evident, but noted some naiveté that might be partially overcome by the kinds of session we could present. He contended, however, that holding the seminar so far in the future presents the problem that it will be too late for the 18 small university-built satellites which are scheduled for launch in November, 2001 - only about a month after our Annual Meeting. He expressed the concern that without proper frequency coordination, these spacecraft could present problems.

Clark further noted that this brings up the entire question of education. He contended that, while it might be important to include all levels, from K through 12, college and graduate level; that is too much. As he has said previously, the task should be split up. Tynan countered that, certainly, one person could not do the entire job. That is seldom the case in any endeavor, he said. The person in charge of the Education Department, must have help from people who specialize in the various levels. Whoever heads the department would concentrate on the particular aspect which he/she is most qualified for and interested in, while others handle the other aspects. However the one in charge must be the focal point for the fiscal side of the department, e.g. collecting budget requirements etc. But, Tynan concluded, creating several departments within AMSAT to take care of various levels of education, does not seem reasonable. For one thing, it would make Martha and Art's job more difficult, not to mention that of the accountants.

Daniels reminded the Board of the need to keep an up-to-date list of the various university satellite projects forthcoming and their status. This, he said, should one of the functions under the Education Department.

It was noted that Steve Bible, current VP Education, has recently moved across the country and begun a new job, so his availability to continue in this post might be in question. Haighton stated that he will contact Bible soon to determine his wishes.

It was agreed that this teaching effort, including the seminar, should not be a profit-centered activity

for AMSAT, although the contributor's expenses should be covered by those benefiting. Some parallels to AMSAT's participation in the MOST project were cited, but Tynan emphasized that MOST is a different situation in that we were asked to be a major participant and that AMSAT's involvement was stressed in the proposal which won UTIAS and Dynacon the award from the Canadian government.

V. Collection of Electronic Donations for AMSAT Items

Williamson pointed out that InstantTrack 1.5 is being offered for electronic download via the AMSAT Web site. Tynan asked if such solicitation of donations via the Internet is in accord with the policy of the institution that supports the site. Williamson responded that the policy of the site's host, the University of California at San Diego (UCSD), restricts its use to non-commercial activities, so the collection of funds e.g., via charge card accounts must be kept separate. He added that there is not a problem as long as the actual commerce is not done on the site, and in this case the software orders are being handled by an off-site company (DigiBuy) which collects the money for AMSAT and provides the download. If it is desired to ship the software on disk, the company would make the collection and provide the shipping information to the AMSAT office. In answer to question from Saragovitz about the cost of this service, Williamson said it is 13.9 percent. He added that it might be possible to have a box on the page to allow the recipient to send the donation directly to AMSAT. The question was raised of how AMSAT can be certain that we get all of the information and funds due us? Williamson replied that we depend on the vendor wanting to maintain a good reputation and at present he had no concerns about this.

Saragovitz suggested adding a 10 percent surcharge to e-commerce orders to offset the extra costs to AMSAT. However, the consensus was that the 13.9 percent being charged is not unreasonable considering the costs we encounter in handling charge account transactions and for packing and shipping. Baker asked if Williamson thought that the Internet ordering procedure would be feasible for the proprietary software such as Nova? Williamson replied that it would require more of the features offered by the vendor at extra cost such as registration codes. Saragovitz expressed doubt that the author of Nova would permit this arrangement and Clark added that Nova nearly fills a CD-ROM and would require a very long time (hours) to download while IT downloads are compatible with normal telephone lines.

Feller emphasized the importance of the fact that when AMSAT supplies items face-to-face e.g., at hamfests, we are not selling but collecting donations.

Williamson stated that if all products and opportunities to make donations were available via the Internet it might be feasible to find a service willing to handle this at reasonable cost.

Saragovitz contended that, while this type of arrangement might work for software, it would not be practical for small items such as patches and decals. Besides, she contended, most of these items are distributed at hamfests.

Clark suggested possibility of getting additional donations by offering a video replay of the Phase 3D launch in the form of a 20-30 MB movie.

Clark offered a resolution that the BoD extend a strong commendation to Williamson for both his efforts in updating and making InstantTrack Y2k compatible as well as arranging the distribution of this software by the Internet. The Board wholeheartedly concurred.

VI. AMSAT Internet Facility

Williamson described the plan to replace the computer presently used for the AMSAT Internet facility. He noted that, while the present computer has done yeoman service for several years it is now displaying recurrent problems. Correction requires a reboot that makes extra work for our host. He said the plan is to soon acquire a new machine at a cost of less than \$1000. It will have 20 GB storage capacity compared to the present 1.5 GB. Saragovitz said that financial arrangements have already been made with the AMSAT office.

Williamson reported that the present machine is backed up daily and emphasized the favorable arrangement with the UCSD host. In answer to a question from Baker, Williamson said that links from the AMSAT site to other sites, including commercial sites, are acceptable to UCSD.

Beyond the aforementioned items, Williamson reported that not much is changing at the Internet facility. He added that the UK members have added a search engine that indexes the AMSAT-NA site as well as theirs. An improved online archive for amsat.bb will also be coming along soon. He reported that there are now about 12,500 mail aliases on our site and approximately 2000 check-ins daily to amsat.bb, plus about 3000 to ANS. With regard to these, he asked for more up-to-date and better organized postings on satellite projects. Feller suggested increasing the ARISS information to a similar level as that presently carried for Phase 3D. Williamson replied that ARISS is now featured on the front page as well as having an extensive page of its own. Haighton noted that Roy Neal has been sending out much publicity regarding ARISS.

It had been reported previously that an individual doing business as *Virtual Real Estate*, has secured the domain names, amsat.com and amsat.net. Feller, noting that Network Solutions has changed policy regarding registrations, wondered if now it might be appropriate to write a letter stating our claim to the name AMSAT, and that issuance of domain names containing AMSAT are inappropriate. Williamson stated that he is unsure exactly what Network Solutions current policy is, but he doubted if such a letter would be beneficial. He also advised against registering of all the *dot somethings* that we are able to think up. Feller stated that he has talked with the individual at *Virtual Real Estate* and assured him that he won't profit from these names, offering only to reimburse him for his expenses of registering them. It was understood that the registration will come up for renewal in January, so the best course might be to wait and see if they are renewed.

Baker suggested a resolution that, for possible future use, we register amsat-na.com. It was concluded that Board action is not necessary to do this. The cost is only \$35, which is well within the budget of

the Electronic Publications Department. It was agreed, however, that it is unnecessary to register amsat.ca to preserve it for Canadian use.

[Before the end of the meeting, Williamson reported that he had already carried out this action and registered amsat-na.com.]

Soifer reported that at the recent Surrey Satellite Forum the AMSAT international group suggested setting up additional web sites that would be separate from the various national sites and accessible only to members. It was pointed out that RSGB and ARRL already have such sites. Williamson commented that his budget could support such an additional site, and volunteered to set it up if desired. However, no consensus was forthcoming as to the need for such a site, and it was unclear what material would be carried on it.

VII. Question of Optional Electronic Distribution of the Journal

Tynan reported on his suggestion of establishing an alternate, voluntary, electronic distribution for the Journal. His hope was that this would permit us to reduce dues for those opting to receive their Journal in this manner, possibly to as low as \$20 per year. However, subsequent consultation with Saragovitz, has revealed that the savings produced would not be nearly enough to permit that great a reduction. Paige pointed out that the printing cost per copy would increase if fewer are printed. Haighton was supportive of the idea, believing it might be particularly attractive for members outside of North America, especially in terms of more rapid delivery. Saragovitz noted that some overseas Journals arrive before her husband's copy. It was generally concluded that the concept is not attractive as a means of offering membership at a lower dues rate under present conditions, but that this decision can be revisited as situations change. Fears were also expressed that making the Journal available electronically would lead to its contents being made more readably available to non-members.

On a related subject, Williamson asked if there is now interest in setting up a Members Only area of the web site for items other than Journal material, e.g., notification of change of address, renewals etc. Saragovitz and Williamson will explore this possibility.

VIII. International and IARU Matters

Soifer reported the good news that, thanks to the work of Frank Bauer, it appears that after ten years of effort, 2-meter frequencies for ARISS have been agreed to - the tentative frequencies await a sign-off by the Russians. He went on to say that, thanks to Williamson's work on the Web site, AMSAT International continues to move along with approximately 30 nations now signed up.

He noted that the next Region II Conference will take place in Guatemala during 1-5 October 2001, and added that his budget request includes funding to attend to represent AMSAT-NA. He further stated that it is our turn to host the next IARU Satellite Symposium, so we must now decide whether to schedule this meeting in conjunction with next year's AMSAT Annual Meeting and Space Symposium. It will be necessary to avoid a conflict

with the Region II Conference.

Soifer continued his report with the news that the IARU Administrative Council has been asked by the U.N. Office of Outer Space Affairs, in Vienna, Austria, to plan an event to help commemorate World Space Week to be held 4-10 October 2001. AMSAT- Southern Africa plans to use that week for a tryout of the parrot repeater on SO-35. Soifer had suggested that this week might provide a good opportunity for a demonstration of amateur satellite operation from 4U1UN. However, while the U.N. Office in Vienna was enthusiastic about the plan, no response was received from U.N. Headquarters in New York. Soifer noted that security concerns have always been a serious issue at 4U1UN, making access by non-U.N. staff members difficult.

Soifer also reported that he had found in the preparatory documents for the IARU Region III, Conference, published on their web site, a paper from the Wireless Institute of Australia (WIA) that was highly critical of AMSAT-NA, claiming (among other things) that we had proposed that 144.39 MHz be used for APRS from the Shuttle and the International Space Station. WIA, in its paper, strongly opposed this as being contrary to national band plans and outside the IARU's international satellite segment of 145.8-146.0 MHz. Apparently, the WIA document had misinterpreted a paper by Bob Bruninga, WB4APR, in the Proceedings of our 1999 Space Symposium, and information appearing on the ARISS web site. Soifer said that he then contacted Graham Ratcliff, VK5AGR, asking about the origin of this misinformation and was told that Graham had been attempting for more than a year, within WIA, to correct this idea and to make it known that there was nothing to it. After consulting with several persons involved, Soifer said that he had written a letter to WIA and Region III on behalf of AMSAT-NA, explaining the true situation. This they filed as a conference document. Both papers were discussed at the recent Region III Conference, resulting in the favorable outcome that WIA corrected their error and the Conference adopted a recommendation, sponsored by WIA, supporting the efforts of IARU Satellite Adviser Hans van de Groenendaal, ZS5AKV, in finding more 2-meter frequencies for manned space and for satellites in general. Soifer added that the Region III recommendation will be discussed at the upcoming Region II Conference, and he will urge Region II to endorse it. He said that it is not clear what Region I will do; its next conference will be in 2002. To become IARU policy, a recommendation must be approved by all three regions and the Administrative Council. Soifer cited, as a lesson learned, that this episode reinforces the point that he made at last year's BoD meeting that people must be careful about what they write in *The AMSAT Journal*, in papers published in our Symposium Proceedings and in what they put on *amsat-bb*. Although authors may intend their comments to apply only to North America, what they write will be read all over the world.

Soifer then discussed the fact that Ratcliff had resigned as IARU AMSAT Frequency Coordinator in March, citing personal reasons. The result is that until a successor is found, van de Groenendaal has been serving in this position, in an acting capacity, in addition to his role as Satellite Adviser. Under the terms of reference for these positions approved by the IARU Administrative Council in 1994, van de Groenendaal is to nominate a candidate who will then be voted upon by the various AMSAT organizations, but he has not yet done so. The final

item of Soifer's report dealt with his concern that many satellite builders and users seem complacent about the continued availability of amateur UHF and microwave frequencies. He noted that the 70 cm and 2.4 GHz bands are under serious attack from other services in much of the world. Another insidious threat is that there are rising noise floors on these bands due to a variety of unlicensed RF sources. Unlike the U.S.A. where there is legal protection against such unlicensed services, in much of the rest of the world this protection does not exist. He suggested that, in addition to working with IARU and its member societies to help protect these bands, AMSAT's long-range strategy should include contingency plans in the event some or all of them cease to be available. Tynan mentioned his idea that, if we still have the band, a satisfactory uplink band might be around 2450 MHz where many microwave ovens and RF heaters operate making these frequencies unsatisfactory for terrestrial use. He added that Phase 3D includes a 2446 MHz receiver to study the noise floor in this part of the spectrum with the expectation that a satellite in high orbit will not hear emissions from such devices. Soifer agreed, but noted that this band is under maximum threat. Tynan added that he considers the 10 GHz band, with 50 MHz of spectrum available to the amateur-satellite service, as a downlink band likely to be especially useful. Clark added that the 2.4 GHz band is seeing increasing use by low power unlicensed devices such as *Bluetooth*. He also stressed that the 23 cm band is yet another that will see much pressure in the next 20 years and noted that we have already lost 1215-1240 MHz to other satellite users, that GPS use will soon extend to 1250 MHz and the new European Galileo system goes up to 1260 MHz.

Another source of concern is Ultra Wide Band (UWB) technology. This uses bandwidths of up to 1 GHz in the 1-3 GHz region. While using relatively low power the aggregate effect is going to cause problems as already encountered in the Washington-Baltimore area. Soifer noted that Guatemala, where the next Region 2 Conference will be held, is a country that has already auctioned off frequencies in the 70 cm amateur band to commercial users.

IX. Amateur Radio on the International Space Station (ARISS)

Frank Bauer, VP for Human Space Flight Programs, reported by telephone. He summarized the presentation he made the previous day at the Space Symposium by saying that things are going well from the human space flight perspective, with the first set of hardware now in orbit. The permanent antennas will be sent up in April, and the crew should start Amateur Radio operations soon using a temporary antenna. The first contact with a school group is scheduled for 18 December 2000. An international ARISS meeting is planned at the Goddard Space Flight Center (GSFC) for 1-3 December 2000 to discuss operational matters and the next generation of hardware, including frequencies. Bauer noted that, whenever he sends out email regarding frequencies, he receives negative feedback. Some of these are easy to answer, while some are not. He cited a recent example of a complaint received from Japan that the 145.490 MHz uplink will be unsatisfactory there. It was noted, by several of the attendees, that 2 meters is extremely crowded in Japan. Franks's response to this will be that he will ask the complainant to work with the ARISS team on this matter and telling him that they had been working with the Region III

Team at the last IARU conference. The consensus at that conference was that occasional use of this frequency would be acceptable.

Bauer said that, with the exception of the above frequency concerns, things are going well. He also stated that there is a contingent of about five volunteers coming each weekend to GSFC to support ARISS development and operations activities. He noted that, in addition to the budget provided by AMSAT for ARISS, NASA has contributed a significant amount (\$140k) of support over the past fiscal year plus the services of one full-time employee. With this help, good progress is being made. Nevertheless, he would like to see more volunteer activity, and will continue to push for this in the coming year.

Bauer added that another big challenge will be to effectively use publicity through *QST*, *The AMSAT Journal* and the Internet. It was noted that it is expected that the Amateur Radio equipment now in orbit will be tested on 9 November 2000. The initial tests will be made with WA3NAN at GSFC and possibly other ground stations, and that regular operation should begin in mid-November. Tynan asked if a press release had been prepared to announce the first operation, to which Bauer replied that the ARRL has already sent out details including the call signs and frequencies to be used. Bauer said he would try to achieve as much press coverage as possible and added that there had been an earlier release pertaining to the transport of the equipment. Baines said that he is trying to get the word out to the Area Coordinators on these recent developments by supplying presentation tools. Bauer offered the materials that he had used for his presentation the previous day and Baines accepted, adding that he would distribute a CD-ROM containing this updated information to the Coordinators. Bauer emphasized that, because of the international nature of the ARISS program, it has been extremely challenging work involving a variety of different cultures and personalities. But, hurdles had been overcome. Amateur Radio hardware is actually now in orbit!

He indicated that the budget for his department is satisfactory and noted that the matching funds promised by ARRL will be very helpful. Bauer was congratulated for his excellent work.

X. Operations Report

Keith Pugh, VP for Operations, reported plans for coverage of the Phase 3D launch, saying that a Launch Information Net will be carried by W1AW and WA3NAN at GSFC. Baines pointed out that information on the launch coverage needs to get out to ANS soon. Tynan noted that video coverage is expected to be available via the Internet and a satellite downlink. Pugh said the Stacey Mills will soon issue updated software for Phase 3D telemetry.

He also noted that the Microsats are deteriorating, e.g. AO-16 has a memory problem. It is hoped that a new load will alleviate this problem.

XI. Publications Report

Journal Editor, Tillman announced that a special Phase 3D issue of the *Journal* is about 75 percent complete and will be distributed to members about three weeks after Phase 3D is successfully launched. He said that the other AMSAT organizations

worldwide had been offered an opportunity to publish items and that this would give this special issue of *The AMSAT Journal* an international flavor. Extra copies will be printed and made available at hamfests and to clubs along with efforts to recruit new AMSAT members. Tillman said the special issue is expected to be a reference document.

Tillman also reported that, in the works is a searchable CD-ROM containing back issues of *The AMSAT Journal* from 1995-2000. Clark asked what the intended contribution to receive this would be, to which Tillman replied that this question is under consideration. A brief discussion followed, with Feller commenting that to maintain historical accuracy, the advertisements appearing in *The AMSAT Journal* should be retained on the CD-ROM.

Tillman noted that more information is needed about Saudisat. Daniels commented that this is a sensitive issue because of the need of the builders to have clearance for almost all information about this spacecraft. An article on Saudisat is anticipated for the March/April issue of *The AMSAT Journal*.

Baker said that he had been approached at the general meeting by an individual who has a complete set of *Orbit*, the predecessor of *The AMSAT Journal*. A discussion followed concerning the collection and distribution of AMSAT archival materials. Clark opined that these CD-ROMs were likely to be much sought after, and suggested obtaining them in sufficient number.

Haighton complimented Tillman and proposed a motion that a vote of thanks be extended for the work and dedication he has expended on the Journal; including the special Phase 3D issue, the CD-ROM project and for his work on the Strategic Planning Committee - all in addition to his job and family responsibilities. The motion was seconded by Baines and passed by a unanimous vote. Feller asked about the budget for publications, to which Tillman replied that it appears adequate.

XII. Field Ops Report

Baines distributed copies of his report describing the highlights of Field Ops accomplishments in 2000. These included representing AMSAT at hamfests, conducting local area nets, making presentations at club meetings, serving as Elmers for newcomers, encouraging satellite activities at schools, hospitals and on Field Day. He noted that Jim Huhta had been recognized the previous day for his enthusiastic and successful support of Amateur Radio satellite activities at a Tampa, Florida hospital. Haighton noted that he had sent a special message of greeting to the patients there. Baines continued, saying that in the past year, the number of Area Coordinators had increased to 166, and that representatives from three countries, not having their own AMSAT organizations had asked to be included. Clark asked if any of the geographic holes that had previously existed were now filled. Baines replied that there still are some. In the March/April 2000 issue of *The AMSAT Journal*, he said he had published an appeal for volunteers to serve in the areas where coverage is missing, e.g., Los Angeles, the Bay Area in California as well as New York City and South Dakota. He added that a revised list of Area Coordinators will appear soon on the AMSAT web page.

The report continued making note that the

Coordinators had been busy handling 38 hamfests between October 1999 and September, 2000. The revenue brought in at hamfests from the distribution of AMSAT materials and the enrollment of new members almost doubled from the previous year. He made a special note of Larry Brown's volunteering to drive 900 miles to make a highly successful presentation at Pacificon 2000 and noted that Northern California is an area where it would be advantageous to have a greater AMSAT presence. He said that we may now have some contacts there that can be counted upon in the future.

Baines went on to list the AMSAT materials that had been updated in 2000 including the excellent revisions of publications done by Gould Smith and Mike Seguin as well as the revised and improved versions of Quiktrack V by Bob McGuire and InstantTrack 1.5 by Paul Williamson. In an effort to keep the Area Coordinators current they were given, at the morning's Coordinator's Breakfast, a CD-ROM entitled The Area Coordinator's Resource Guide. It includes Phase 3D pre- and post-launch information developed by Tillman and Baines. This has recently been enhanced with graphics supplied by Chas Richards. He said that this constitutes a significant improvement over the floppy disk called The Area Coordinator's Tool Kit, that was distributed at last year's Annual Meeting. Clark asked if sound is included on the new CD-ROM, to which Baines replied "not yet". Clark opined that audio of the satellite signals has been of interest in the past as well as being useful for archival purposes. Baines said there was extra space on the CD-ROM for this to be added and welcomed contributions of sound material. He added that updated CD-ROMs will be sent as needed because there is so much material that is new.

The group attending the breakfast was larger than anticipated and exhibited much enthusiasm. Thus, a greater participation around the country is expected in the coming year.

Baines summarized future activities as enlisting additional volunteers to gain additional representation at hamfests, having more participation on the AMSAT nets and making more information available on the web site. Tynan said that, while we are doing better at gaining new members, the comment has been received that, other than receiving the Journal and a packet of introductory materials, we tend to leave new members hanging. He thought that one way of improving this situation might be through the various AMSAT nets, with the Houston AMSAT a prime example. He urged that more publicity be given to the nets. Page asked if Williamson could put a link to the Houston Net on the AMSAT Web page. He added that getting more repeaters to pick up the nets would be useful. Tynan added that the Houston net might continue the practice used in the past of scheduling interviews with various experts on a subjects such as the Easysats, ARISS and Phase 3D.

Baines noted that the new member packet contains the Net Schedule, the list of Area Coordinator's and the Resource Guide, recently updated by Mike Seguin. With this material, they should be informed as to how to access other resources.

Clark mentioned that photographs taken at the Phase 3D launch in French Guiana site might also be assembled on a CD-ROM and displayed at hamfests as a slide show. Baines said that some

these photos are to be incorporated into the special P3D issue of the Journal. Tynan said that he and McFadin had videotaped some of the activities at the Orlando lab and other scenes in connection with the construction and checkout of the satellite. He expressed the hope that a professional quality video history of Phase 3D could be prepared, possibly in time for the 2001 Dayton Hamvention. This could be an important item at the AMSAT booth, he thought. Various volunteer resources that might be available to produce such a video production were discussed.

The meeting adjourned for the evening at 8:52 PM. It reconvened the following day, Monday, 30 October 2000 at 9:08 AM with Baines, Baker, Clark, Daniels, Feller, Haighton, MacAllister, Paige, Pugh, Saragovitz and Tynan present.

XIII. Auditor's Report

Treasurer Feller distributed the audited financial report for 2000 prepared by the firm of Verkouteren, Auerbach, Olsen and Co. He said the audit was in good condition and complimented Saragovitz for her excellent record keeping skills that made the auditor's work less difficult and thus kept down the cost.

Feller asked the Board for two motions, one to accept the auditor's report and the other to retain the services of the firm of Verkouteren, Auerbach, Olsen and Co. for the coming year. Tynan moved the first with Clark seconding. It passed unanimously. Clark then offered the second motion and Tynan seconded. It also passed unanimously. Saragovitz noted that no letter suggesting improvements in our financial management accompanied this years report. She observed that this was because they found nothing negative on which to comment.

XIV. AMSAT Involvement with the Microvariability Of STars (MOST) Project

Haighton began the report by expressing the concern that those at the University of Toronto Institute for Aerospace Studies (UTIAS) have not been heeding our advice, as much as he would like. He went on to say that when he and Baker visited with the MOST project managers last February, they took the strong position that if UTIAS failed to listen to the AMSAT team's recommendations, their project was likely to fail. Following that, some changes were made to the architecture of the satellite and UTIAS people did call in people like Chuck Green to review fabrication techniques. Subsequently, their proficiency in putting things together has markedly improved. However, upon consideration of some of their recent questions it appears that UTIAS continues to be burdened by a lack of practical knowledge and experience. The design phase of the project is now nearing an end and they hope to have some hardware built and in place by the end of 2000. Then, they have approximately one year to do extensive testing. Haighton plans to have the AMSAT team meet again with the builders in Toronto to give a final

review and provide them with an opportunity to make final modifications. Feller urged that this not be an official approval of the completed project, but merely an opinion that it appears satisfactory.

Tynan expressed concern regarding the thermal situation and the lack of testing to verify the analysis. Haighton replied that UTIAS sees no need for such testing, and does not have the money for it. Instead, they want Dick Jansson to conduct a thorough review of their thermal analysis, but contend that they should not have to pay for such service, believing it to be within the scope of AMSAT's contract. Haighton reported that he has made it clear to them that it is not. Nevertheless he offered to pay part of the cost. However, UTIAS refused to pay for even part of such activity.

With regard to thermal testing, Haighton indicated that while Jansson had expressed confidence in the design and he is not recommending it. Clark countered, saying that in a recent conversation with Jansson, he learned that Dick still has some serious concerns and agreed that a re-verification of their analysis is a good idea. Clark speculated as to what will happen if Jansson's further analysis disagrees with UTIAS's. Will it make any difference? He added, if AMSAT, through Jansson's work goes through the additional evaluation and UTIAS chooses not to accept it, and then there's a thermal failure, our risk has increased. Clark then recommended that we do nothing more and let the MOST managers take the heat. Tynan replied that it will still look bad for AMSAT if the satellite fails.

Tynan said that his thermal concern is the same as it was in the beginning. The MOST spacecraft is a relatively thick structure which has one face toward the sun for weeks at a time. That has not changed and cannot be changed by analysis, he noted. He contended that this situation could be rectified, through the use of deployable, relatively thin, solar panels. But, UTIAS has rejected this approach because of dynamics concerns.

Baker summed up the voiced concerns, noting that our agreement with UTIAS is structured such that we can recommend, but they are not obliged to accept our recommendations. He fears that an on-orbit failure could well damage our reputation when it comes to any future associations of this nature. He urged that we be certain to document all our recommendations. Tynan strongly agreed. Feller reminded everyone that the way the contract with UTIAS is written AMSAT has no sign-off requirement although the perception might be otherwise.

Baker asked if AMSAT has fulfilled its obligations in fulfillment of the agreement? Haighton said that, in his opinion, AMSAT has already provided a huge amount of assistance and has not only fulfilled, but exceeded, the terms of the agreement. In return UTIAS has, thus far, met all of its financial obligations to us.

Haighton added that an interesting side aspect of the project was the plan of the Canadian Space Agency (CSA) that is funding MOST is to design a microsatellite that, although it may never be launched, will be a learning experience for them. Interestingly, they have been consulting with some of the same AMSAT advisors who are advising MOST. Apparently, CSA has been favorably impressed by the advice they have received, and has carefully followed the recommendations. In

response to a question, Haighton answered that these people are, in this case, acting as individuals, not in the name of AMSAT. He was then asked if CSA was aware of the differences that exist between what AMSAT is recommending and what UTIAS is doing? Haighton replied that he did not think so. He believed that they have been accepting what UTIAS is telling them. He emphasized that it is not our role to report to CSA on MOST, but only to advise UTIAS.

Baker noted that, in addition to revenue-generation, one of the primary purposes for AMSAT establishing a relationship with a non-amateur satellite project, such as MOST, is that it would serve as a way to learn how to work with the educational community and serve as a model for similar activities in the future.

XV. LEAST (The AMSAT Package on MOST)

The MOST project has asked that our Amateur Radio LEAST package be ready by the end of January 2001. Haighton expressed confidence that this goal would be achieved and at a lower cost than had been budgeted.

Haighton proceeded to describe recent events concerning the LEAST (Lots of Extra Amateur Stuff on the Telescope) satellite project. Its AMSAT builders had delayed their start due to a lack of a clear launch opportunity. Then in August 2000 the situation began to look better, and they began to get things together. Bdale Garbee is doing much of the design and Lyle Johnson is heavily involved along with Chuck Green, Mark Kanawati and Matjaz Vidmar. Because there have been changes in the MOST satellite the format of LEAST has been changed from the original plan for a Mode L/S bent pipe operation to a L/S band digital communications package. This change is required because there will be insufficient power for the bent pipe transponder.

The frequency scanning receiver is being configured as an interference scanner for all amateur bands from HF through L band and possibly S band. For this an ICOM R10 receiver board is used. The digital board is a 156 k modem. The question remains as to how to mount and point the antennas. Tynan asked how the LEAST package would be tested for space worthiness. Haighton replied that the MOST mission is expected to last only one to two years, so LEAST is not being designed with the same intent for a long life in space as has, for example, Phase 3D. Tynan noted that on a mission carrying an optical telescope, extreme care must be taken to avoid outgassing problems. He expressed confidence that the LEAST team is well aware of this.

XVI. Employee Performance and Compensation Review

At this point the meeting went into a closed session to deal with administrative matters including Saragovitz's performance review and compensation. While no record was made of this session, after the open session resumed a motion was made by Clark that Martha be nominated to serve as Manager, which is a "Big O" (Top Level) position. Baker seconded and the motion passed by a unanimous vote.

XVII. Phase 3D Progress Report

Daniels reviewed the prelaunch activities and reported that everything has gone smoothly at Kourou. He said our relationships with the authorities there has been outstanding and these professionals have been extremely helpful. Kudos were extended to Peter Guelzow and Chuck Green for their handling of matters at the launch site.

Tynan inquired as to whether the Arianespace people are aware that more than one international organization has been involved in the construction of Phase 3D. Daniels responded, that, although all the negotiations have been with AMSAT-DL, they were aware of us, particularly by the presence of Chuck Green.

Baines, who assisted in the process, reported that everything has been moved out of the previous Phase 3D lab at the Orlando airport and the equipment taken to a new facility that is in a building attached to the hanger in which Stan Wood maintains the corporate aircraft which he flies. McFadin has been doing work on ARISS at the new site. It was noted that it is smaller than the previous Phase 3D lab. Work is progressing toward arranging the remaining AMSAT equipment in the new lab. The clean room was transferred to the University of Central Florida (UCF.) Some of the unneeded items will be sold. Rent and other costs for the new lab will be much less than for the previous location.

Haighton noted that McFadin has been serving as Lab Manager, which he has not been an AMSAT officer position, and as such, has not been receiving all the information that officers are privy to. He recommended that McFadin be recognized by elevation to the status of an appointed AMSAT officer, so that he will receive more information and can be made responsible for certain expenditures. So saying, President Haighton announced that, pending discussion with Frank Bauer (because McFadin is now working exclusively on ARISS) and Stan Wood, VP Engineering, he is appointing McFadin Manager of the Orlando Lab, which becomes an AMSAT officer position.

Tynan noted that the lab facility has been budgeted at \$7000 for the year.

XVIII. Phase 3D Financial Wrap-Up

Baker summarized the Phase 3D financial picture from 1993 through 30 September 2000. He stated that AMSAT-NA has spent approximately:

\$411,000 for components,
\$900,000 for contracts,
\$77,000 for communications,
\$230,000 for travel
\$455,000 in other various categories.

This makes a total in the order of \$2,075,000. In 1995, some \$210,000 was sent to AMSAT-DL to be applied to the launch. So, AMSAT-NA's contribution thus far has been about \$2,286,000. In reviewing these figures, he acknowledged the excellent assistance of Saragovitz and Feller which made possible the accurate keeping of these rather complicated financial records.

Baker continued noting that the figure to complete the project can be approximated by adding to the above, a sum estimated at \$13,000, to be expended from October until time of launch. The major change, from what was expected to be spent, is due to the decision of AMSAT-DL to support the lodging for all AMSAT personnel in Kourou. Another significant offset that will show up as income was the cost to ship the spacecraft, which was paid by AMSAT-UK. So, the total cost of the Phase 3D Project to AMSAT-NA will be somewhere in the neighborhood of \$2.2 to \$2.3 million.

The income figures going back to 1993, and listing separately the contributions of AMSAT-NA, ARRL, AMSAT-UK, JAMSAT and AMSAT-DL show about \$1,100,000 donated by those in the U.S.A. Baker noted that is an amazing display of generosity. ARRL contributed approximately \$528,000. With that, plus the amounts from AMSAT-UK, JAMSAT and AMSAT-DL, and substantial contributions from many other AMSAT-affiliated organizations in some two dozen countries throughout the world, the total income, that flowed through AMSAT-NA's books, comes to just over \$1,900,000. Additional funds that might be expected to be raised up to the time the project is complete are estimated to be in the vicinity of \$20,000. Thus, Baker concluded, by the end of the Project, AMSAT-NA's spending on Phase 3D is expected to exceed what we have taken in by about \$300,000.

Tynan observed that he believes it entirely appropriate that AMSAT-NA should expend some of its own funds to support Phase 3D, particularly in the light of the other AMSAT organizations which contributed, many of them sums far in excess of what we did on a per-member basis.

Clark asked about the \$1200 budgeted for expenses in 2001 and wondered if it was because of expenses incurred in the last three months of 2000. He added that there may be a significant amount spent on operations to bring the spacecraft on line after launch. Feller said that this is already accounted for in the budget for the Operations Department. The possibility of incurring travel expenses for ground station operations was mentioned as one possible type of expense. Tynan recommended that Pugh discuss this matter with Stacey Mills and suggested deferring approving the final budget until the question of upcoming Phase 3D operations is clarified. Clark also noted that, it might be a good idea to assemble the Phase 3D participants for an evaluation and critique and suggested that this be budgeted as a valid Phase 3D expense, rather than an operating expense.

As discussion ensued as to how to answer when we are asked what Phase 3D cost and what it would have cost if built by a commercial satellite builder? The consensus was that the total out of pocket cost of the satellite was in the order of \$ 4 million. What it would have cost, if contracted with a commercial company, is a more difficult question. Numbers from around \$100 million to \$200 million have been mentioned. But, since it wasn't contracted with a commercial company, the Board concluded that a more specific figure is hard to pin down.

Clark reminded the BoD that Phase 3D operations are to be determined by the Program Board that is made up of representatives from the organizations which contributed very large sums to the Project. Membership is AMSAT-DL, DARC, AMSAT-UK, ARRL and AMSAT-NA.

Tynan urged that the new President discuss the next meeting of this Board with the Phase 3D Project Leader,

XIX. Amendment of By Laws to Clarify the Question of Nominating Board Members by Electronic Mail

Saragovitz stated that a question has arisen as to whether BoD nominations can be made by fax or email. Upon checking the By Laws, she found that *written nominations* are specified. She seeks the opinion of the Board whether this restricts submissions to those written and sent by paper mail.

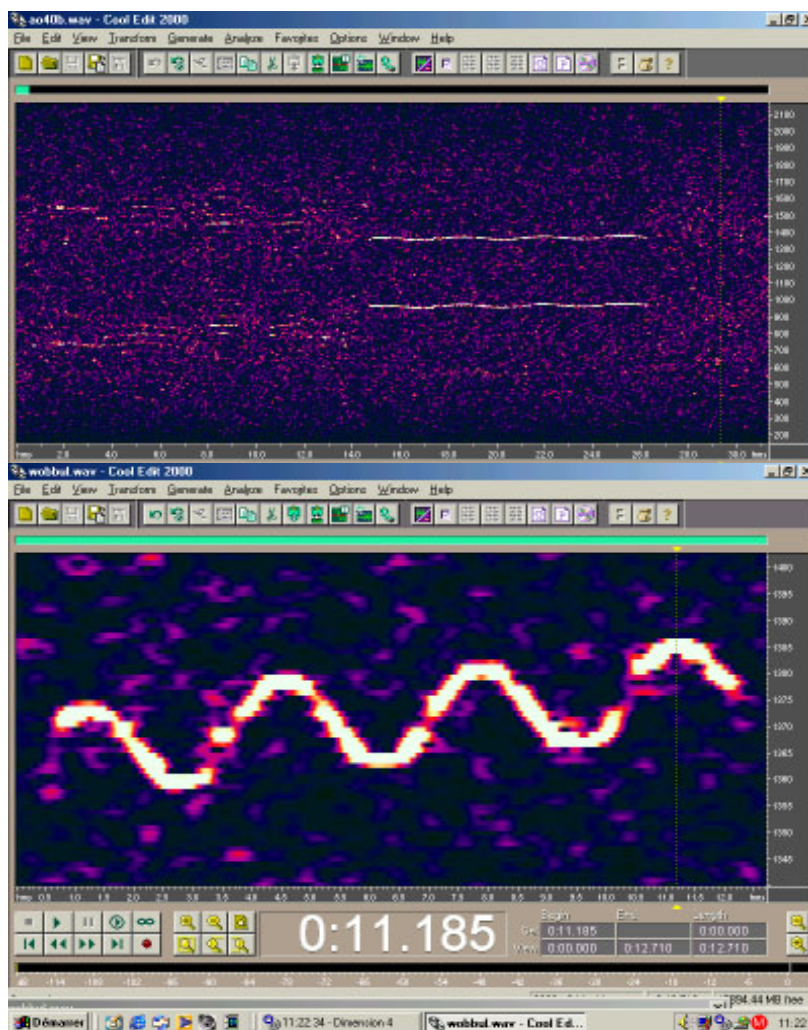
It was agreed that fax messages containing a signature are acceptable. However, it was concluded that e-mail submissions are not.

XX. Marketing of the Kansas City Tracker by AMSAT

Saragovitz announced that L.L. Grace Communications has elected to no longer market the Kansas City Tracker/Tuner (KCTT), and has proposed that AMSAT take over responsibility for distributing the device, while they continue to supply and support the completed units. Under this arrangement, AMSAT would be responsible for advertising, printing the manual and making copies of the software disk, plus boxing and shipping the units.

A protracted discussion ensued which included comments that Steve Bible's EasyTrak unit, which TAPR is to market, is expected to be cheaper and be compatible with more modern computers.

Saragovitz emphasized that the value of undertaking



AO-40 Wobble. Jean-Louis Rault, F6AGR provides the above figures to illustrate the fact that the spin rate of AO-40 can easily be measured with the sharp frequency analysis of the 2.4 GHz telemetry beacon. The spin of a satellite induces a relative motion between the sat antenna and any observer and this produces a nice Doppler frequency wobble. A 17.46 rpm spin can be computed from the oscillation period displayed in the bottom figure which is an enhance figure of the top figure. A frequency shift was plus/minus 7 Hz on that audio record of the BPSK telemetry signals was recorded by F6AGR near Paris, France on 04 January 2001. The FFT display shows freq versus time. The vertical axis shows frequency and the horizontal axis is a measurement of time. Equipment: 23 turns RHCP helix; Modified Drake 2880 converter; Icom IC-821H transceiver used as 145 MHz IF; and CoolEdit 2000 software.

this arrangement, in addition to the money it can bring in, is providing a source for a product many of our members want, noting that it has been a popular item in the past. The point was also made that it is compatible with older computers which are found in many hamshacks. The question of how technical support would be provided was answered by the statement that the same person presently performing this service, has agreed to continue, and L.L. Grace will continue to pay that person.

Clark questioned whether or not, our embarking on this enterprise might negatively affect our relationship with TAPR, which is to come out with the EasyTrak quite soon. He pointed out that we have enjoyed a good relationship with TAPR in the past, including several joint projects. Haighton agreed to discuss the matter with TAPR President, John Ackerman and report back to the Board.

It was agreed that we will table any action on this until after hearing from Haighton.

XXI. Other Matters

Tynan brought up the subject of establishing a procedure for bequeathing money to AMSAT, possibly in the form of a trust arrangement. Soifer opined that it would not be practical for us to set up a *money management* operation but he suggested a Charitable Trust approach through an appropriate organization. Daniels recommended a Foundation strategy as done by some churches. Clark announced that John Kitchen who is an attorney with a firm doing trust management had appeared at the recent Annual Meeting offering assistance on problems of this sort. Clark added that another member has implied that they might endow a ground station project. Clark went on to suggest that the BoD submit the estate and endowment ideas to this new volunteer for advice.

Soifer reminded the Board that we have already established a precedent for accepting contributions in the form of stock. Feller agreed, saying that we now have services through AMSAT's broker to accommodate the acceptance of stock. Clark urged that written guidance be made available to prospective donors. Feller replied that this had been published in *The AMSAT Journal* but agreed it should be made available as a separate document.

Saragovitz suggested contacting ARRL for their pamphlet on this topic and agreed to do this.

In response to a question by Tynan, Soifer said that, if enough money were involved to get it started, a trust management company would handle this for us but we are not likely to be in that \$100 million league. Feller responded that our broker is able to manage this for us as they do for other 501(c)(3) organizations.

Tynan concluded the discussion with the suggestion that a policy be adopted, possibly based on the ARRL pamphlet, then we can announce the venture and Feller volunteered to look into the entire matter.

XXII. Future Annual Meeting Sites

Pugh said that volunteers in Fort Worth have suggested holding a future AMSAT meeting in that

area. Clark noted that Dallas/Fort Worth is one of the easiest places to get to by air. Board members agreed that this group pursue this possibility for a meeting site in 2002, and do the long range planning.

Haighton said that members in the Toronto area have stated that they would like to host a meeting in that city in 2003. He was given the go-ahead to start planning.

XXIII. Adjustment and Approval of the Budget

Feller summarized the planning numbers to now show a deficit of \$39,403 with an expense total of \$357,203.

Clark noted that the Education Department looks under-funded at a time when we need to take a more pro-active position with regard to university groups building satellites. Daniels suggested adding \$5000 to that department.

XXIV. "Atta-boys" and "Atta-girls"

The following persons in addition to those mentioned in the text above were recognized for their contributions to AMSAT:

- Keith Baker for serving with distinction for two years as AMSAT President as well as his many other efforts and accomplishments.

- George and Caroline Caswell for their excellent hosting of the 2000 Annual Meeting.

- Steve and Diana Diggs for agreeing to host the meeting in Atlanta next year.

- Frank Bauer and all of the members of the volunteer ARISS work force.

- Peter Guelzow, Chuck Green and all of those making up the work force at Kourou, French Guiana.

- Bob Twiggs, Cliff Buttschardt, Randy Kohlwey and Assi Freeman for their support of university satellite projects.

- Robin Haighton, our single point of contact for MOST, and all of those who have volunteered their time and talents in support of our participation in that project.

- Lou McFadin, Stan Wood, Barry Baines and all of those who helped move materials to the new lab in Orlando.

- Bruce Paige, Mahata Paige, Andy MacAllister and all who participate in putting on the Houston AMSAT Net and making it available nationwide.

- Perry Klein, W3PK for his continuing to maintain the AMSAT Key Workers List.

- Russ Tillman for preparing the CD-ROM of Phase 3D information for the Area Coordinators.

- Art Feller for his help in preparing the Budget.

- Martha Saragovitz for her efficient management of the AMSAT business office and its affairs.

- Bob Carpenter and Bill Hook for their help at the AMSAT office.

- Chas Richards for his work in providing updated CD-ROMs for the Area Coordinators.

- Mike Gilchrist for serving during the past year as the Alternate Board member.

- Amish Parashar, Todd Kerner and Gus Moore of the Thayer School of Engineering at Dartmouth College for their presentation at the Symposium concerning modular nanosatellites.

- Francis Marion and Joyce Sawtelle at 73 magazine for producing the Special Hamsats issue of 73 *Amateur Radio Today*.

- Richard Limebear, Gerald Brown, Andy MacAllister, Roger Cooke and Simon Lewis, authors of the articles appearing in the Special Hamsats issue of 73 *Amateur Radio Today*.

- Bill Hook, for his accurate transcription of the taped minutes of Board meetings. His fine work greatly facilitates the Chairman's task of publishing the minutes.

- To all who volunteer to serve our organization, too numerous to mention. The Board apologizes for not singling out each and every one of you.

XXV. Adjournment

Chairman Tynan declared the meeting adjourned at approximately 1:20 PM on Monday, 30 October 2000. He announced that Board will reconvene by teleconference to review the budget and other matters that may come up. ■

Errata

Reference is given to page 6 of the November/December 2000 issue of *The AMSAT Journal* which cited that AMSAT-UK raised over \$100,000USD for Phase 3D. In fact, AMSAT-UK has donated to \$440,000 to the Phase 3D project with a large amount being shared by AMSAT-DL, University of Surrey and other various builders of Phase 3D equipment in the United Kingdom.

Reference is given to page 14 of the Special Phase 3D issue which shows photographs of Phase 3D's bays. Mistakenly, Bay 5 was referred to as Bay 6 and vice versa.

Field Ops Update: Showing the Flag

Barry A. Baines, WD4ASW

One of the highlights of the annual AMSAT Symposium is the Field Ops Breakfast held on Sunday morning. This is an opportunity for Area Coordinators to get together and share success stories, discuss ideas on how to better represent AMSAT in our respective communities, recruit additional Area Coordinators, and help motivate our volunteers to try new approaches towards meeting the challenges of the coming year.

The breakfast held at Portland in October 2000 was well attended with over 50 volunteers. For the first time, we distributed an *Area Coordinator Resource Guide* on CD-ROM that included PowerPoint® presentations (*AMSAT Phase 3D Satellite Brief* and *Introduction to Amateur Satellites*), a PowerPoint® viewer (no need to own PowerPoint® to run these presentations), an Area Coordinator Listing, and a Phase 3D Frequency Chart in PDF format. Since release of the initial CD-ROM, we are in the process of updating our Resource Materials to include an enhanced AO-40 Brief (to replace the Phase 3D presentation), WAV and MP3 audio files of various satellite broadcast transmissions, and updated Field Ops information. Our goal is to have this new CD-ROM sent to every Area Coordinator by the end of March. These materials are designed to provide the Area Coordinator with materials to make club presentations and enhance their ability represent AMSAT in their local communities.

In addition to distributing these resources on CD-ROM, we are also in the process of making available on the AMSAT web page up-to-date listings of our Field Ops organization so that anyone who is interested in learning more about the amateur satellite program can contact someone locally. Hopefully, by the time you receive this issue of *The AMSAT Journal* you will find the latest Area Coordinator listing on the AMSAT website. Our aim is to make it not only easier to disseminate information concerning the Field Organization, but to respond more quickly to local needs.

From the discussions that were held during the Field Ops Breakfast, it is clear that there are a number of people who are doing some pretty exciting activities to help AMSAT in their local communities. The list of accomplishments ranges from local school presentations/ARISS-SAREX contacts to running local AMSAT nets on club repeaters and making club presentations. We also discussed the need to attract the next generation into our hobby. Several Area Coordinators described their efforts to bring amateur satellite communications and space science into their local

schools. Among the ideas that were shared included:

- Coordinate visual sightings of the International Space Station and Space Shuttle as a means of attracting local interest.
- Utilizing amateur satellite communications as a basis for developing a curriculum in the classroom.
- Working with local astronomical societies to broaden interest and attract additional potential hams.
- Demonstrating satellite communications using the Fuji Sats during evening passes and AO-27 during daylight passes with Arrow Antennas and appropriate transceivers at local club meetings.
- Developing relationships with local chapters of the National Space Society and Challenger Society as another mechanism for broadening local awareness.
- One-on-one/Elmer with new satellite users.

An overlooked resource is the Houston AMSAT Net, which is available via Real Audio (www.amsatnet.com) and via satellite on Tuesday evenings. The International AMSAT Information Net (1800Z Sunday on 14.282MHz) is another source of information, which includes the latest AMSAT News Service (ANS) bulletins.

We also discussed the fact that while the amount of time that each volunteer can allocate for AMSAT related activities may vary and each individual will have different areas of interest, setting goals at the beginning of the year and monitoring our progress towards achieving those goals is an effective tool for ensuring success. One Area Coordinator, Gard Forrester, KF6GAQ, has developed "Plans and Priorities" as a means to clarify thoughts and prioritize his future activities relative to representing AMSAT. Gard took the time to define and prioritize six different goals that will help him to develop relationships in his area and increase support for AMSAT in his community. The fact that Gard took the time to organize his thoughts and share his ideas with others will ensure a greater probability of success in helping AMSAT in the Pacific Northwest. I encourage everyone to take the time to think about and define for themselves what their personal goals will be for supporting AMSAT in 2001, recognizing that every AMSAT member has an opportunity to enhance the success of our organization by contributing their time and skills. Hopefully, the ideas that were shared at Portland will provide a basis for developing your personal goals for helping to improve the quality of our organization and encourage others to experience the excitement of space communications. ■

SSB ELECTRONIC USA

PHASE 3D Equipment Headquarters

SSB Electronic USA features world class VHF - UHF - SHF equipment.

The latest gear from: SSB Electronic, Kuhne Electronic - DB6NT, M2 Antennas, Beko Electronic, EME, Procomm, AIRCOM PLUS, AIRLINK, ECOFLEX and WINRADIO is available.

- Mast Mounted Preamplifiers 144 - 2400 MHz.
- Ultra Low Noise LNA's 50.0 MHz. 24.0 GHz.
- Transverters 50 MHz. - 24.0 GHz.
- Antennas - Rotors
- Downconverters and TX Upconverters for all P3D frequencies
- Mode "S" Downconverters
- Mode "L" TX Upconverters
- Linear Amplifiers 50 MHz. - 24.0 GHz.
- Ultra Low Loss Coaxial Cable
- Transverter Kits 1.2, 2.4, 5.7 & 10 GHz.
- Parabolic Dishes

So What's New?

BEKO Electronic: 144 MHz. - 1296 MHz. Linear Amplifiers 100 Watts - 1200 Watts

DB6NT Electronic: MKU 24 OSCAR Mode "S" Downconverter IF 144 or 432 MHz.

MKU 10 OSCAR 10.451 GHz. Down Converter

MKU 24 G2 OSCAR 2.4 GHz. Transverter 1 Watt

MKU 57 OTX 5.6 GHz. OSCAR TX Upconverter **plus more.....**

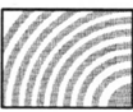
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